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EUCALYPTUS IN CALIFORNIA.

By NORMAN D. INGHAM.



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EUCALYPTUS IN CALIFORNIA.

By NORMAN D. INGHAM.

INTRODUCTORY NOTE.—The importance of Eucalyptus culture in California from a commercial standpoint has reached a stage which can no longer be overlooked. The growing scarcity of hardwood fuel and lumber, poles, ties, and other forms of timber makes certain an increasing demand and price for any material which can supply this want. The almost incredible rapidity of growth of certain species of these trees, their thrift and hardiness under conditions unfavorable to most cultivated plants, and the general appreciation of their value as wood and timber, which is rapidly coming about, have created within comparatively recent times a great interest in Eucalyptus culture, amounting almost to a "boom." Many groves are being planted on a greater or less scale, railroad companies are investigating the possibilities of Eucalyptus as a supply of ties, poles and timber, lumber companies are taking up the matter and several stock-selling corporations have been formed for planting and selling Eucalyptus groves.

Under these conditions there is a decided need of some comprehensive and reliable information as to the possibilities and methods of growing these trees, the commercial qualities of the different species, their adaptation to conditions in the various parts of the State, and the quality and amount of the product which can reasonably be expected from them. The present bulletin by Mr. Ingham represents a very complete and practical study of the subject, based on careful observation over all the cultivated portions of the State south of Shasta County, and the facts presented may be taken as reliable and conservative.

The preparation of this bulletin has been undertaken by Mr. Ingham as a part of the work of the University Forestry Station at Santa Monica, of which he is in charge. For a number of years this Station has been growing and distributing Eucalyptus seedlings of various species, and many of these have been planted in various parts of the State. On the Station grounds some seventy different species may be seen growing in mature form. At present it is possible to obtain all the ordinary species of nurserymen at moderate prices, so that the necessity no longer exists of an extensive distribution by the State, except by the sending out of seed, or possibly a limited number of trees of uncommon and promising species. The greatest field of usefulness for the Station at present, as regards Eucalyptus culture, is along the line indicated by this bulletin, the investigation of the commercial and economic side of the question. Following the present study, which is necessarily, in large part, of a general or preliminary nature, we hope to continue with an investigation of the commercial uses and possibilities of Eucalyptus timber, for the various purposes indicated in this bulletin. Mr. Ingham shows the possibility of producing this wood in California in almost unlimited amount. If statements appearing almost daily in the public press are to be believed a hardwood famine is imminent in this country. If, therefore, it be true that species of Eucalyptus are equal to our native hardwoods as lumber, great possibilities are open in this direction. It will be the purpose of the Forestry Station to demonstrate the quality and uses of the wood of the most important species in a more definite manner than has hitherto been done, in coöperation with users and handlers of hardwood lumber in this section. In this manner great good may be accomplished for the State by aiding the progress of a most important industry.—RALPH E. SMITH.

Eucalyptus, a genus of trees of the family *Myrtaceae*, was introduced into California from Australia and the adjacent islands, and several

species were planted in the district of San Francisco Bay previous to 1860. There are to be found growing in the central parts of the State, both on the coast and in the interior, groves of considerable area which are forty to fifty years old.

Since the introduction of the first species of *Eucalyptus*, the seeds of other species have been imported each year by seedsmen, nurserymen, and in many cases ranch owners, until at the present time there are growing in the State nearly one hundred species. The University of California has seventy named species growing on the Forestry Station grounds at Santa Monica, Cal.; there are specimen trees of nearly every species over ten years of age, and bearing seed at the present time, while there are young trees of all the promising lumber *Eucalypts*.

From this large collection there can be selected species that will grow on nearly any soil in a frostless region, while there are a few that can endure temperature as low as 18° F. without injury. There are a few *Eucalypts* that can stand extremes of temperature from 20° F. to 120° F., and at different altitudes; but with these trees it is as with any other, there is one certain location best adapted to the greatest development: it may be a situation near the coast in a foggy atmosphere, the river bottom lands, the inland valleys or in swamps. Care should be taken in selecting a species for any certain locality, that the conditions there are the ones which will bring the species in question to the highest point of development.

The *Eucalypts* were first set out as a curiosity, on account of their rapidity of growth and as ornamental trees around gardens and buildings, with a possibility of their supplying the owners fuel and fence posts. In these respects they have fulfilled the original planter's expectations, and more, for in a few localities the sawmills are now sawing the largest logs into valuable hardwood lumber.

Eucalyptus planting has now passed the experimental stage and may be considered without question as a commercial proposition. The value of the crop and the possibilities of growing it in California have been sufficiently demonstrated to make judicious plantings even on a large scale perfectly safe, with an assurance of sure and reasonably large profits. It is important, however, for the planter to consider, in the light of the best information, the nature of the product which he will produce, or, in other words, the market which he will attempt to supply with his *Eucalyptus* trees.

Eucalypts may be used either for fuel or for hardwood lumber. For the former purpose the prevailing prices of wood in most of our cities and large towns during the past few years have been such as to make the fuel proposition appear extremely attractive. Many glowing prospectuses are being offered to the public on this basis. It should be

remembered, however, that the production and use of natural oil is rapidly increasing; that gas and electricity for heating purposes are cheap in the cities, and that all three are coming more and more into use every day in the place of wood. In fact, wood as fuel is rapidly becoming a luxury, and there is in the mind of the writer no reason for expecting any increase in its use as fuel by the general public. He, therefore, believes it unprofitable and unwise to enter upon Eucalyptus planting with the sole idea of raising wood for fuel. The profits to be derived from Eucalyptus in the future will be found in hardwood lumber for wagon work, farm and other implements, railroad, coach, and house finishings, furniture, etc.; ties, telephone poles and bridge timber will also prove profitable. For any of the above named products of Eucalyptus at least ten years' growth will be required, and of course the older the trees the greater the profits in proportion.

EUCALYPTUS FOR TIMBER.

The wood of the different species of Eucalyptus varies from a wood as soft as that of our pines, to very hard, close-grained, and variously colored kinds equal to our native oaks and hickories. Among the large number of species may be found some that can be substituted for nearly all our present commercial woods, although the Eucalyptus wood is harder to work.

The Hardwood Planing Mill of San José, Cal., has sawed up many thousands of feet of Eucalyptus lumber during the past winter, the bulk of which is from *Eucalyptus globulus* logs over thirty years old. This company is filling orders for felloes of large wagon wheels, poles, singletrees, doubletrees, and reaches, haypress blocks and insulator pins. The Eucalyptus lumber is being used in every place where great strength is required, and the finished product is valued at the same price as oak lumber. Other mills are also sawing this wood to some extent in a local way, and its value for all hardwood purposes is becoming more and more appreciated. *Eucalyptus rostrata*, the Red Gum, is now finding considerable use for interior finish and furniture, and both this species and the Blue Gum, *Eucalyptus globulus*, are becoming established as commercial hardwoods. There is no doubt of their greatly increased use if supplies were available.

Eucalyptus timber is more costly to cut and mill than any of our native hardwoods: in planing, the lumber of many of the species has a tendency to chip on account of the irregular grain, while that of all of the species under the most careful handling season-cracks more or less on the ends. This fault can be overcome by having the logs sawed a foot or two longer than the finished product needs to be, so that the season-cracked ends can be removed. Very little trouble is

experienced in seasoning the lumber if the trees are cut down during the winter months and sawed while green, and the lumber then piled in high tiers to obtain weight, in some place protected from the wind and sun.

Eucalyptus has been used in the last few years quite extensively for pilings, which paid well until competition lowered the price; at present a pile fifty feet long and ten inches in diameter at the small end is worth between \$10 and \$12. Under ordinary conditions it requires from eighteen to twenty-four years to grow a pile. The prospect for the use of certain species of Eucalyptus for railroad ties and telephone poles is also good.



Fig. 1. *Eucalyptus globulus*, wood from 3-year-old sprouts; 20 cords per acre; 128 cubic feet per cord.

EUCALYPTUS FOR FUEL.

The wood of most of the Eucalypts makes good fuel. A grove of Blue Gums five years old, set out 6 by 6 feet apart, under favorable conditions should yield from 50 to 80 cords of wood per acre, while at ten years of age 80 to 150 cords may be expected. Groves under irrigation will undoubtedly do better than the above figures indicate, while the quality of the land will also, of course, have a great influence.

The cost of working up the standing trees into fuel ready to burn varies somewhat with the age and species of the trees. Two companies near Santa Paula, Cal., recently let out the cutting of their wind-breaks

around their ranches by contract. The trees on one ranch were twelve years old when cut, and the contract was taken and completed by a company of Japanese for \$3.25 per cord, although they claimed to have lost money. The other company's trees were thirty years old, and the contract was taken for \$3.50 per cord by a company that had a power saw and splitter; although this latter company was well equipped they were compelled to give up the contract and leave their tools for the debts they had incurred. Most of the Eucalyptus grove-owners figure that it has cost half the market price of the wood to cut it, varying, of course, with the price and with the age of the trees. In most instances the grove-owners are cutting down their trees for



Fig. 2. *Eucalyptus globulus*, 22 years old.

wood when from five to ten years old, nearer five than ten as a general rule, and it is self-evident that it is much easier to cut up five-year-old trees than thirty-year-old trees into stove wood, consequently it is less costly.

EUCALYPTUS FOR OIL.

The leaves and twigs of the tree, when distilled, produce an oil which has great medicinal properties, and is used quite extensively in medicine at the present time. This oil is a non-irritant antiseptic, which can be used without the slightest injury on all the tissues of the body and internally in very small quantities. The amount of oil that can be extracted from a certain number of pounds of leaves and twigs varies with the locality in which the grove is situated, in the different trees according to their positions in the grove, and in the different species of Eucalyptus. The latter is also true in regard to its medicinal properties.

The leaves and twigs of the *Eucalyptus globulus*, or common Blue Gum, are used exclusively at the distillery at Garden Grove, Cal. It is claimed by Mr. J. C. Mitchel, in charge, to be the only species growing in sufficient quantities in that locality and producing a sufficient amount of oil per hundred pounds of leaves to make distilling profitable. The brush from cut-over areas is generally trimmed up, only the smallest twigs and leaves being used. The leaves from the brush of ten cords of wood, cut from trees five years of age, distill from one and a half to two and a half gallons of oil, or two tons of leaves and twigs will produce from three to four gallons. The cost of distilling



Fig. 3. Eucalyptus oil distillery.

the oil is stated as a little over forty cents a pound, or \$3 a gallon, seven and one half pounds to the gallon. The oil sells wholesale at from fifty to sixty cents a pound, or from \$3.75 to \$4.50 a gallon. At the present time the distilleries are having trouble in disposing of their supply of oil from last winter's distilling.

QUALITY OF SOIL FOR EUCALYPTUS PLANTING.

The question is asked by many, "From what kind of land will the Eucalyptus return the greatest profits in the shortest time?" The answer is, the best land that it is possible to buy, with the grove under the most correct treatment. The idea is too prevalent that Eucalyptus growing is exclusively a proposition for cheap, dry, or poor land. It

is true that the trees, especially certain species, will live and grow fairly well under conditions where no other crop could be considered, and if the object is merely the utilization of such land to the best advantage Eucalyptus planting may be wise and somewhat profitable. For one, however, who is buying land for this purpose, or one who already has fairly good land capable of irrigation or naturally moist, it is becoming more and more apparent that good land, capable of culture and irrigation, will produce far more profitable returns on the investment by reason of the enormously more rapid growth and greater wood production of the trees. Under such conditions a crop of trees may be produced and marketed and the land then either cleared for other purposes or the stumps allowed to sprout for a second crop, when on poor, dry land trees of the same age would not pay for cutting.

Eucalyptus planting commercially has a number of points in its favor as an investment over the fruit industry, principally because the fruit business is more or less of an uncertainty, while the timber proposition is comparatively sure. A heavy rain during the blooming period of the fruit trees checks fertilization, a small crop being the result: this is not the case with the wood crop, where the more rain the greater growth and profits. The harvesting period of most fruits extends over but a few weeks, and if it is not gathered at that time the crop is a total loss; while on the other hand the harvesting period of the timber trees extends over a lifetime. The price of labor may be high, or the value of the wood much lower than usual; if either is the case the trees may be allowed to stand. The following year they will be larger and more valuable.

METHODS OF GROWING EUCALYPTUS.

The Propagation of the Seedlings.—The necessary conveniences for the propagation of the seedlings are as follows: seed boxes or flats, a good soil, seed true to name, plenty of water convenient to all flats, and in most localities a shade for the young plants from the sun is required.

The Flats.—Boxes can be bought very cheaply from the grocery stores, that will make, when sawed up, flats of varying sizes: flats in the shoo sawed to any size can be bought from the box factories at a very reasonable price. Flats 22 by 16 inches in size, outside measure, will hold one hundred transplanted plants, although they can be made larger or smaller and handled practically as well, but the depth should not be over three inches, so that the roots of the young plants will have a tendency to spread out, instead of forming a long tap root that is liable to be either cut or broken off in transplanting.

The Soil for Seed-bed.—It has been proven that Eucalyptus seeds will germinate and grow in nearly any soil, from a clear beach sand to adobe, but the best results are obtained if the seeds are sown in a light loam, while a medium loam mixed with about one fourth well rotted horse manure should be used in the transplanting flats.

The Seed.—When buying the seed, care should be taken to deal with reliable seedsmen, for otherwise a season's growth may be lost by sowing seeds not true to name. Eucalyptus seed can be bought at from \$4 to \$15 per pound according to the species and the seedsman's reputation. In many localities seed of a few species can be gathered, such



Fig. 4. Method of gathering Eucalyptus seed.

as the common Blue Gum, *Eucalyptus globulus*; the Manna Gum, *Eu. viminalis*; the Red Gum, *Eu. rostrata*; the Sugar Gum, *Eu. corynocalyx*; the Swamp Mahogany, *Eu. robusta*, and a number of others that are scattered over the State.

The Amount of Seed to Buy.—The number of fertile seeds of any species to the pound is very high; the average number of transplanted plants raised to the pound is 12,000.

The seed of most species can be gathered at all times of the year, although the greater amount mature during the summer and fall. The seed cases should be gathered from the trees when the valves begin to open and placed on sheets of canvas or blankets in the direct rays of

the sun, which will open the valves, allowing the seed and chaff to fall out.

Shade for the Young Plants.—Where a large number of plants are to be grown, a lath house, with the lath spaced their own width apart for the protection of the young plants from the midday sun, will be found more convenient than lath or cheese cloth screens laid on small frames above the flats, as the labor required to move them each time the plants are watered would amount to a large item of expense during the growing season. The lath house or the screens will also protect the seed flats from the ravages of the birds and the young plants from

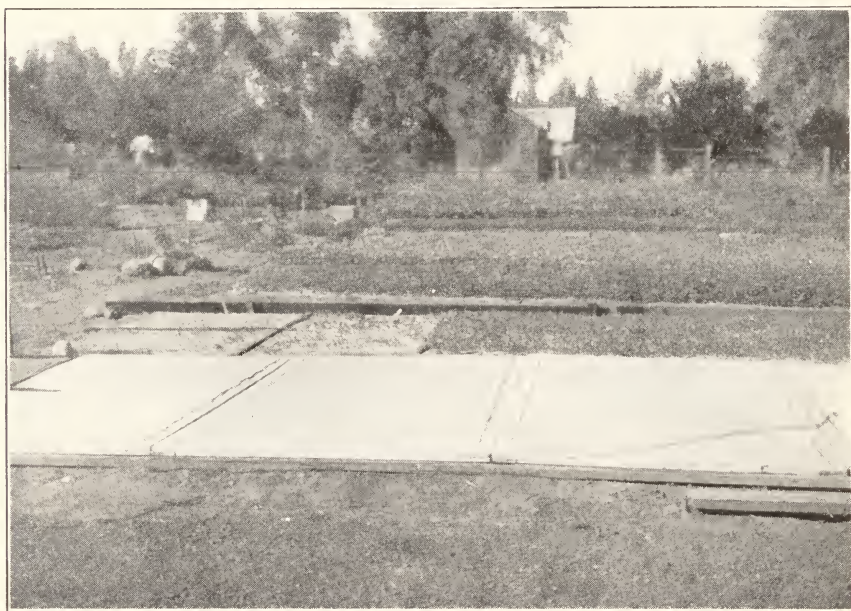


Fig. 5. Eucalyptus seed-bed, in cold frames.

the frosts (if not too severe) during the cold weather of the winter months, before the time for setting in the field.

The size of a lath house for a desired number of plants can be figured out, twenty-eight transplanted plants to the square foot, or an area sixty feet square will hold one hundred thousand transplanted plants and allow ample room to go among the flats to water them.

The Time to Sow the Seed.—The time to sow the seed varies somewhat with the locality, but as a general rule the seed should be sown by the latter part of June or first of July, and the seedlings from these sowings will be large enough to be set out in the field the following spring, if they receive proper care while young.

Methods of Sowing the Seed.—The seed is generally sown broadcast in the seed flats and the young plants transplanted once before being set in the field, but some persons take the trouble to sow one seed in a place and space them in the flats. By this method transplanting is unnecessary, while others sow the seeds in hills and practice thinning, instead of transplanting, before setting out in the field. This latter method is used in some localities of the San Joaquin Valley with good success, because of the great trouble experienced in transplanting during the hot summer months in that region.

However, in the event of either of these methods being used to sow



Fig. 6. Eucalyptus seedlings, *rudis* and *viminalis*.

the seed, fill the flats to a depth of two and one half inches with the prepared soil, pressing it down firmly in the boxes, then sow the seed and cover them to a depth of not over one fourth of an inch with the same soil, sand or sawdust, pressing this covering firmly over them. The best results have been obtained at the Forestry Station by using sand, while the Experimental Forestry Company of Hanford, Cal., have had better results with redwood sawdust as a covering and mulch for the seed flats than with any other material.

Care of Seedlings.—The seed flats should be kept damp through the heat of the day, until the young plants break the ground, then care must be taken not to use too much water and that there is a good circulation of air over the flats, or the fungous disease “damping off”

is liable to occur. Damping off is most general on damp, cloudy days and where the plants are watered late in the evening, as there is very little evaporation from the earth's surface at night. This disease can be prevented by using practically no water on cloudy days and only in the mornings on clear days. Some species most susceptible to damping off are as follows: *Eucalyptus corymbosa*, *Eu. citriodora*, *Eu. calophylla*, *Eu. ficifolia*, *Eu. globulus*.

Transplanting.—If the seeds are sown broadcast in the flats, when the young plants have reached a height of from two to three inches they can be transplanted to other flats of prepared soil and spaced from one and a fourth to two inches apart. The best results in transplanting are obtained if the plants are hardened off for a few days beforehand by checking the water supply, allowing them to become quite dry. The soil into which the young plants are transplanted should be kept damp, and the plants should be protected from the direct rays of the sun for a few days.

The Time to Set the Plants in the Field.—The time to set the plants in the field varies with the climatic conditions or localities and whether the plants are to receive irrigation or not. In localities where frosts are common through the winter months, it is advisable to set the trees out as early in the spring as possible without endangering them to a late frost and still have them receive the benefit of the late rains, so that they will have a full season's growth to withstand the frosts of the following winter. If the trees are to be irrigated, they can be set out later in the season without danger of loss from want of moisture.

Size of Plants When Set Out.—To insure a good stand the plants should not be under six or over ten inches in height when set in the field; to a certain extent the smaller the plants when set out the better the results afterward, although the size varies somewhat with the species and the locality.

Blue Gum seedlings have been found, in many instances, to make a better stand in the coast regions if set out when they are from four to six inches in height. Better stands are obtained in the San Joaquin Valley if the seedlings of all the species are from ten to twenty inches high when set in the field. In many species the roots are as long if not longer than the plant's own height above ground, and this is a family of plants that will not stand a large amount of mutilation to the root system, consequently better results are obtained from setting out small plants.

Preparation of the Land.—The land upon which a Eucalyptus planting is to be put out should be thoroughly plowed and harrowed. The

fields can be marked out in the check system by horses with cheaply constructed wooden markers, although the rows probably will not be as straight as in the fields laid out by hand, but the trees will be the same distance apart in the rows in either direction and cultivation can be carried on as easily as in the more carefully laid out fields.

The Distance Apart to Set the Young Trees in the Field.—The distance apart, in setting out the seedlings in the fields, becomes a problem to the owner. The species of *Eucalyptus*, the soil, the distance to water, and whether the trees are to be grown for fuel, ties, or lumber, all have to be taken into consideration. Some species of *Eucalyptus* must be



Fig. 7. Natural seedlings of *Eucalyptus globulus*.

planted nearer together than others in order to obtain straight poles; that is, some species are naturally straight growing trees, while others grow out of the perpendicular unless set in close plantings. If the soil is heavy rich loam, the trees can be planted as close as 6 by 6 feet apart unless irrigation is to be practiced. In the latter case, 4 by 8 feet would be the right distance, thus leaving an eight-foot space for ploughing out the irrigating ditches each year. If it is a lighter soil on which the planting is to be made, 8 by 8 feet is the proper distance, or 6 by 10 feet if irrigation is to be practiced.

The close planting has a tendency to sacrifice the diameter growth in favor of the height, also making more erect trees and forming a perfect

canopy with their crowns that will shade the soil, nearly preventing evaporation, as well as any vegetable growth on the forest floor. Close planting matures a greater number of perfect trees, as the struggle for supremacy or the survival of the fittest is worked out as in nature. In this way all the weaker are killed in a few seasons, and the food supply allotted to them by nature is taken up by the stronger ones.

The Setting of the Plants in the Field.—After the land has been prepared the young plants can be brought into the field on a low truck, driven between the rows. The plants can be distributed directly from the truck to the men setting them out on both sides, or the flats can be placed at intervals along the rows. The plants should be blocked out in the flats before being brought into the field, by drawing a sharp knife between the rows. If care is taken to set out the young plants with this small amount of soil around their rootlets, the shock caused in transplanting is reduced to a minimum. Each planter should carry a trowel, to make the holes that are to receive the young plants at the intersection of the marked lines. These holes should be of a depth that the plants can be set from one half to an inch lower in the soil than they originally were in the flats. Each plant should have the soil pressed firmly about it and receive a small amount of water, unless the soil is moist from recent rains.

Care of the Young Plantings.—Thorough cultivation forms a mulch that checks evaporation and kills the weeds that would necessarily take up a large amount of the young seedling's food supply if they were allowed to grow; therefore cultivation should be carried on as long as possible without danger of injuring the young trees by driving a horse between them. The plantings can generally be cultivated for the first season and part of the second before the limbs of the trees spread out and interlap so that it is impossible to drive between the rows. It is an acknowledged fact that the only way to obtain a good stand, and give the trees a start, is to cultivate and take care of the plantings from the time of setting out. However, there are to be found in the State a number of groves that have been set out on land that is too hilly or rocky to cultivate and the trees have made fair growths, although not great enough for similar lands to be recommended for commercial purposes.

Thinning of the Young Trees.—It is a self-evident fact that to grow large trees for lumber a greater space than 6 by 6 feet is needed for each tree to reach a large diameter, but at the same time it would not be good management to set out just the number of trees to the acre which we expect to mature. Trees are killed by gophers and rabbits;

others by extremes of temperature. It is practically impossible to replant in the missing spaces after the young trees are one year old, for the soil is full of the roots of the surviving trees. We have seen trees gophered when two years of age and sixteen feet in height. Companion trees of the gophered ones certainly had roots extending over an area with a radius equal to their own height.

The chance of replants living and producing valuable trees is extremely small. To produce good poles, ties and lumber straight trees are required: very few trees will grow irregularly if they are started straight the first year. Close planting produces straight growing trees.



Fig. 8. Young grove of *Eucalyptus globulus*, end of first summer.

It is a known fact that however well the trees may be grown and planted there will be a considerable number of weak, inferior ones in every thousand set in the field. These can be easily picked out in a grove during the first year and the contrast in growth will be even greater the second year if they are allowed to remain. They not only have little value in themselves, but they are an injury to the better trees by their presence. Therefore, a planting upon any good soil may with advantage be set out 6 by 6 feet apart (1,210 trees to the acre), and at the end of the first year a rigid thinning should be started, removing with a grub hoe all weak, inferior or injured trees. This thinning should be carried on until only the strong and healthy trees, or a certain number, remain to the acre. By this method which amounts to

helping nature work out the survival of the fittest, some trees will stand at the original distance that they were planted while others will stand at multiples of that distance. The extra cost of close planting will never be noticed when the largest possible stand of healthy trees is guaranteed, which is practically the case under this method. If thinning is carried out as many planters contemplate, by a set plan, removing every other one or two trees, many strong and healthy trees will be sacrificed.

Care of the Trees.—The value of a plantation when ten years old



Fig. 9. *Eucalyptus globulus*, 2 years old, under irrigation.

will depend most largely on the care that it received during the first four or five years of its growth. To receive the greatest returns possible from a planting necessarily means that the greatest possible number of perfect trees must be brought to maturity. Consequently, one of the most essential points in regard to the growing of perfect trees is that they start to grow erect with clean trunks the first few years. Some trees will naturally start in this way, while others fork, producing a number of lateral branches on their trunks that nature can not remove in the natural pruning of the trees; therefore, men should be sent through the plantations each year removing all limbs that have a tendency to deform the trees. After the third or fourth year the trees

will have grown to such a height that to remove the limbs may prove impractical in most cases.



Fig. 10. *Eucalyptus globulus*, 4 years old.

At this period (the fourth or fifth year) there enters a new problem: the removal of the poorer trees for wood and stakes to allow the remainder a larger area of soil to draw upon and a greater space

above ground to extend their branches. At this time the trees on an acre can be reduced to a certain number, leaving these to grow for telephone poles, ties, and lumber, or the entire grove may be cut for stakes and wood. Each owner will have to figure out for himself the time at which his grove will bring him the greatest returns, whether for poles, ties, stakes, wood or lumber. At present in the Imperial Valley it would be profitable to cut a five-year-old grove for stakes, while in the northern part of the San Joaquin Valley or the lower part of the Sacramento Valley it would be more profitable to let the grove grow for from ten to fifteen years for ties, fence posts, wood or lumber.

The Care of the Planting After the Cutting of the Crop.—If the



Fig. 11. *Eucalyptus globulus*, 10 months' growth of sprouts after cutting.

leaves are not to be distilled for oil, the brush should be piled and burned as soon as the wood, ties, posts, or logs have been removed. To obtain the best results and largest growth from the stumps in the form of sprouts, it is absolutely necessary that the crop be removed from the planting as soon as possible after it is cut and then the leaves and brush be burned at once, or otherwise the sprouts will start to grow and a large number will be killed or injured in removing the crop or burning of the brush at a later date.

Sprouts will start out from the stumps in from three to six weeks from the date the trees are cut down, in any month of the year. The number of sprouts to the stump is generally large, as is recorded in another part of this bulletin. To obtain the largest profits from the sprout growth in the shortest length of time it is necessary to go

over the planting when the sprouts are from six months to a year old and remove all but from two to four of the largest and most erect growing, leaving them well spaced around each stump. If all of the sprouts are allowed to remain their growth is retarded, as there will be a struggle to live. Finally, a number of the stronger ones is all that remain, but Nature's thinning is an inferior one because she allows too many sprouts to remain on each stump for all or any of them to mature into trees of a profitable growth to the owner.

The Second Cutting Shows an Increase in Quantity.—That the number of cords per acre at the second cutting is greater for the same length of time is due to the fact that where there was originally but one tree, there grows up a large number of sprouts, which should be thinned out to from two to four of the strongest. These sprouts make a more rapid growth than their parent tree, due to the fact that they have a fully developed root system, which is capable of supplying the food to a mature tree.

The Danger of Loss by Fire.—Every person who is looking into the proposition of the growing of the Eucalyptus commercially comes at some time to the question of loss by fire. The writer has seen a large number of trees of the following species: *globulus*, *corynocalyx* (Sugar Gum), *cornuta* and *rostrata* (Red Gum), standing but slightly scarred about their trunks after the grass had been burned about them. A few of the smaller trees were completely defoliated, but in most cases sprouts grew out along the branches, and in cases where the trunks were so damaged that the trees were killed above the ground sprouts grew up from the roots.

The trees in danger from fire are those in wind-breaks around hay-fields or in groves where the trees have been set at such distances apart that their crowns are unable to form a canopy that will shade the ground enough to check the native vegetation from growing. In groves set 8 by 8 feet apart or less, it will be only a year or two, with an ordinary growth, until their crowns will have formed a complete canopy that will cast a dense shade, nearly eliminating the growth of any native vegetation. Then the only material to be found on the forest floor will be a small amount of weeds and leaves, over which a fire could pass but slowly, causing very little, if any damage. However, in all cases precautions should be taken to keep fires out of the plantings, as the least damage to the trees goes against the profits of the grove.

The Power of Sprouting.—The question of whether a certain species of Eucalyptus will send up sprouts after the seedling trees are cut off, is asked by many prospective growers. We fail to know of a species that will not sprout after being cut, or one that will not sprout at any time

of year after the trees are cut down; a stump sometimes dies without sprouting, but it is an exception, not common to any one species.

On May 2, 1907, one tree each of ten species of *Eucalyptus* was cut down, and on October 2, 1907, the number of sprouts to each stump, diameter of stump, and the height of the largest sprout of each species were measured. The Blue Gum sprout measured was not one of the largest, as the stump had been driven over and many sprouts destroyed during the latter part of the summer; the sprouts of the other species had never been injured in any way.

Eucalyptus globulus (common Blue Gum); the stump measured seven and one half inches in diameter, it had twenty-one sprouts, and the largest was forty-five inches in height.

Eucalyptus corynocalyx (Sugar Gum); the stump measured five and one half inches in diameter; thirty-five sprouts were growing around it, and the largest one measured fifty-two inches in height.

Eucalyptus leucoxydon; the stump measured five and one half inches in diameter; fifty-two sprouts were growing around it, and the largest one measured forty-one inches in height.

Eucalyptus polyanthema; the stump of this species measured three inches in diameter; fifteen sprouts were growing around it, and the largest one measured seventy-one inches in height.

Eucalyptus punctata; the stump of this species measured five inches in diameter; forty-two sprouts were growing around it, and the largest one measured forty-five inches in height.

Eucalyptus rostrata; the stump measured five and one fourth inches in diameter; eight sprouts were growing around it, and the largest one measured forty-one inches in height.

Eucalyptus siderophloia; the stump measured four and one half inches in diameter; fifty-five sprouts were growing around it, and the largest one measured forty-seven inches in height.

Eucalyptus Stuartiana; the stump measured five and one half inches in diameter; fifty-nine sprouts were growing around it, and the largest one measured seventy-one inches in height.

Eucalyptus tereticornis; the stump of this species measured four and one half inches in diameter; two sprouts were growing from it, and the largest one measured forty-two inches in height.

Eucalyptus viminalis; the stump of this species measured eleven inches in diameter; sixteen sprouts were growing around it, and the largest one measured sixty-five inches in height.

There are a large number of other species on the Forestry Station grounds that have been cut down, all of which sprouted.

Natural Seedlings.—Many plants growing in countries far from their native homes will not reproduce themselves from seed naturally

in the soil. The Eucalyptus produces seedlings naturally to a considerable extent in California, along the southern coast. At the present



Fig. 12. *Eucalyptus globulus*, 10-year-old sprouts.

time there are to be found on the bluffs near Port Los Angeles, one and one half miles northwest of Santa Monica, thousands of *Euca-*

lyptus globulus (common Blue Gum) plants and seedlings ranging in age from six months to three years. There are seedlings of the fol-

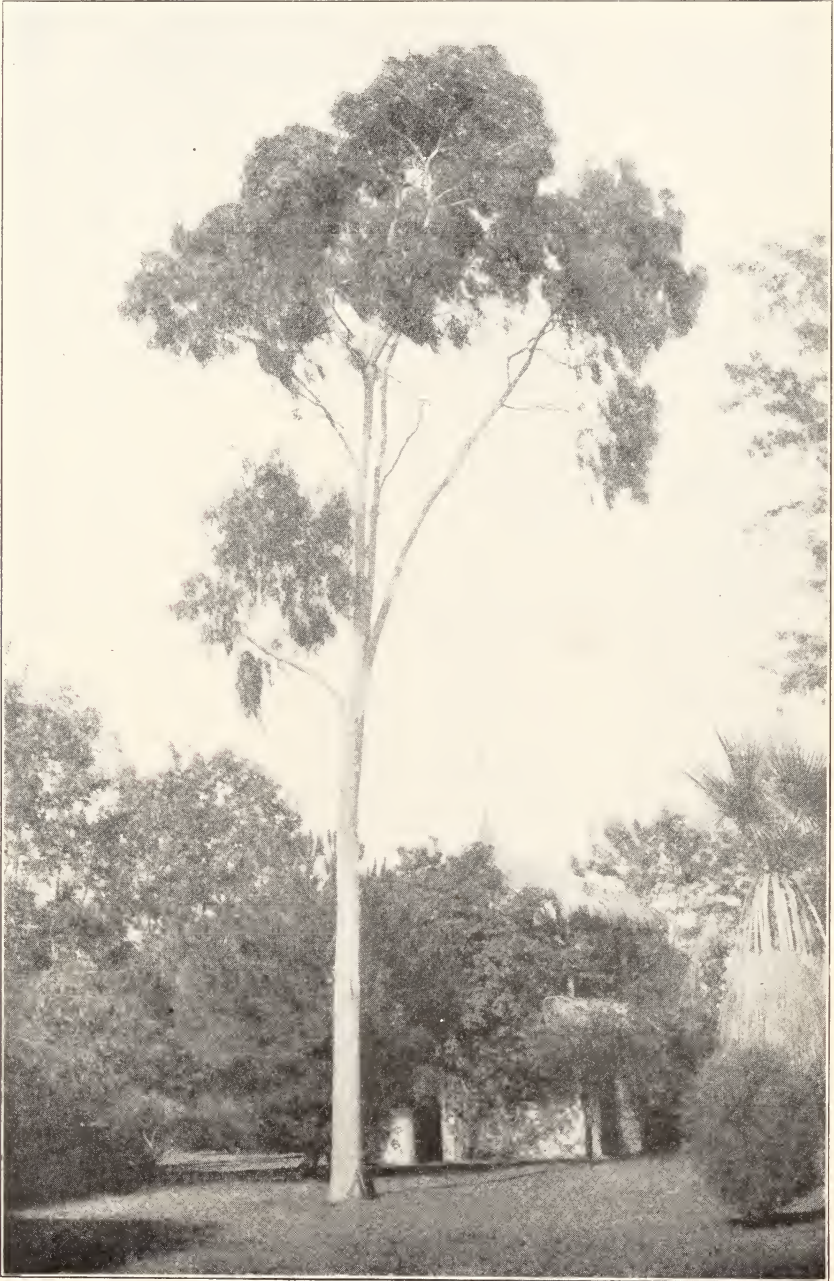


Fig. 13. *Eucalyptus citriodora*.

lowing species in large numbers on these bluffs: *Eucalyptus corynocalyx*, *cornuta*, *leucorylon*, and *Gunnii*.

In the old grove on the Forestry Station grounds a large number of seedlings come up every year after cultivation is stopped in June.



Fig. 14. *Eucalyptus diversicolor*.

Some of the species recorded as having volunteered are as follows: *Eucalyptus citriodora*, one specimen now three years old; *punctata*.

five and six feet in height at the present time; *leucoxydon*, *corynocalyx*, *globulus*, *polyanthema*, and *siderophloia*.

There are a few small plants among the Eucalyptus street trees on Seventh street and Nevada avenue, Santa Monica.



Fig. 15. *Eucalyptus rostrata*, 22 years old.

THE SPECIES OF EUCALYPTUS TO BE FOUND GROWING IN CALIFORNIA.

This list does not purport to be absolutely complete for the localities mentioned, but is sufficient to give a good idea of what species are growing in the State.

At Chico, Butte County, in the Sacramento Valley, the climate is too severe for planting as a commercial enterprise, though the most resistant species like *Eucalyptus globulus*, *rostrata*, and *viminalis*

grow fairly well. The following species were tested at the Chico Forestry Station ten years ago and found to be too tender for that region:



Fig. 16. *Eucalyptus rudis*.

Eucalyptus cosmophylla, *cinera*, *Lehmannii*, *acmenioides*, *andreana*, *botryoides*, *decipiens*, *floribunda*, *citriodora*, *ficifolia*, and *calophylla*:

while the following, although they made a small growth, are too tender for the locality: *rudis*, *tereticornis*, *resinifera*, and *diversicolor*.



Fig. 17. *Eucalyptus sideroxylon*, 26 years old.

The Eucalyptus trees around Yuba City and Marysville are of the species *globulus*, or common Glue Gum, and *viminalis*. Mr. B. F. Wal-

ton has a fine grove of *Eucalyptus viminalis* thirty years old situated some three miles southwest of Yuba City.

Mr. H. A. Alspach, Superintendent of East Lawn Cemetery, Sacramento, received a shipment of twelve species of *Eucalyptus* from this Station in the spring of 1906, and in January, 1907, the only surviving species were as follows: *tereticornis*, *rostrata*, *rudis*, and *diversicolor*.

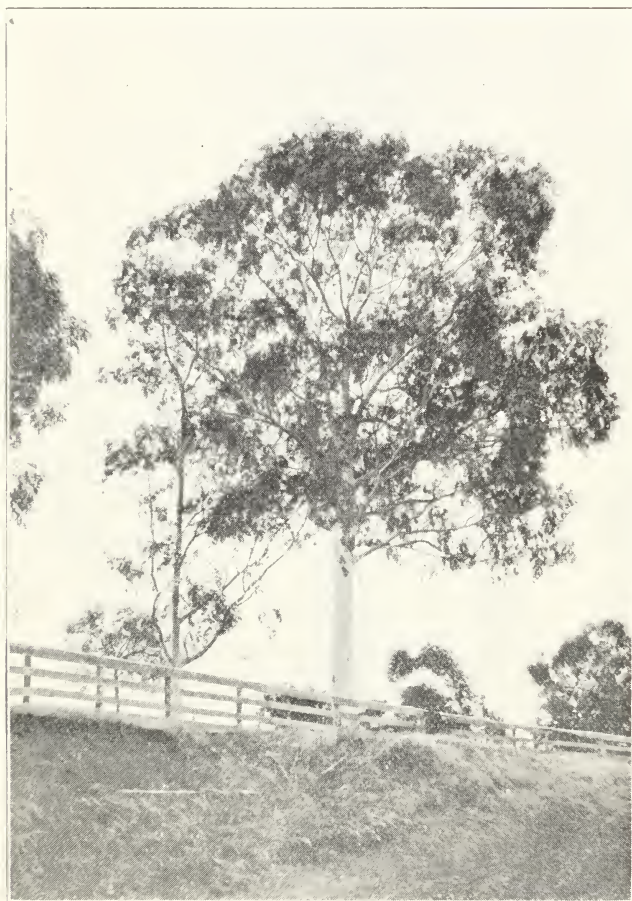


Fig. 18. *Eucalyptus viminalis*.

In the vicinity of Elmira there are growing the following species: *globulus*, *rostrata*, *viminalis*, *paniculata*, and *melliodora*. Although there are a number of species growing in the north, *Eucalyptus globulus* forms the bulk of all the plantings over ten years old; in fact, as well in the southern part of the State as in the northern part.

On the grounds of the University of California, at Berkeley, the following species are growing: *Eucalyptus viminalis*, *rostrata*, *globulus*, *resinifera*, *amygdalina*, *Eugenoides*, *paniculata*, *pilularis*, *obliqua*,

citriodora, *Gunnii*, and others. There are large groves of the common Blue Gum, *globulus*, growing on the hillsides at North Berkeley; and a small grove of very fine *globulus* trees at the entrance to the University grounds from the Berkeley railroad station.

At San José the following Eucalypts are found: *globulus*, *rostrata*, *viminalis*, *Stuartiana*, *corynocalyx*, *rudis*, *polyanthema*, and *tereticornis*.

At Salinas *Eucalyptus rostrata* and *globulus* are to be found in small numbers.

At San Luis Obispo *Eucalyptus globulus* has been the only gum set out to any extent, although at the present time there are a number of persons contemplating the setting out of large plantings of *rostrata* and *tereticornis*.

At Santa Maria, northern Santa Barbara County, the following Eucalypts are growing: *corynocalyx*, *citriodora*, *cornuta*, *cornuta* var. *Lehmannii*, *rudis*, *rostrata*, *robusta*, *sideroxylon* var. *rosea*.

The Hon. Ellwood Cooper has one of the largest collections of Eucalypts in the State at his ranch, twelve miles north of Santa Barbara at Ellwood; some of the species are as follows: *citriodora*, *globulus*, *diversicolor*, *hemiphloia*, *rostrata*, *tereticornis*, and *viminalis*.

In the vicinity of Santa Barbara are to be found groves of *robusta* and *globulus*, and specimens of *botryoides*, *microtheca*, *sideroxylon* var. *rosea*, *corymbosa*, and *amygdalina* var. *angustifolia*.

At Ventura there are trees of *globulus* and *robusta*.

From Santa Paula to Piru there are trees of *globulus*, *rostrata*, *viminalis*, *robusta*, and *polyanthema*; all of these species have made good growths in this region.

From Port Costa to Fresno, on the Valley railroad line, there are but few groves of Eucalyptus, practically all of which are of the species *globulus*, or common Blue Gum.

In the city of Fresno and vicinity there is to be found quite a large collection of Eucalypts, some of which are as follows: *rudis*, *robusta*, *rostrata*, *crebra*, *viminalis*, *polyanthema*, *paniculata*, and *globulus*.

At Hanford, Cal., the Experimental Forestry Company has tested a large number of Eucalypts and have found that the following: *tereticornis*, *globulus*, *rudis*, *rostrata*, *siderophloia*, *resinifera*, *viminalis*, *crebra*, and *Stuartiana* will withstand the climate of that region and make a good growth. The Sugar Gum, *Eucalyptus corynocalyx*, *punctata*, *diversicolor*, *ficifolia*, *calophylla* and *citriodora* all succumb to the frosts.

There are six different species that have made a fair growth at Tulare, as follows: *amygdalina*, *Gunnii*, *rostrata*, *viminalis*, *globulus*, and *resinifera*.

The largest grove of *Eucalyptus sideroxylon* known to the writer is situated at Garden Grove, Cal., and is twenty-six years old. The other species in this locality are *rostrata*, *globulus*, *corynocalyx*, and *viminialis*.

In the vicinity of Orange, Cal., there are the following species in wind-breaks and street trees: *Eucalyptus sideroxylon*, *robusta*, *corynocalyx*, *rostrata* and *globulus*.

On the Bixby Ranch, northeast of Orange, there has been set out this last spring over seventy acres of land in the foothills to the following species: *Eucalyptus tereticornis*, *crebra*, *corynocalyx*, and *globulus*.

Eucalyptus globulus predominates in the country around Santa Ana and Tustin, with a few trees of *rostrata*, *corynocalyx* and *robusta*.

There is a large planting of *Eucalyptus corynocalyx* near El Toro on the Santa Fé railroad line.

From Santa Ana to Del Mar, practically the only species growing is the Sugar Gum, *Eucalyptus corynocalyx*. At Del Mar there are a large number of trees of the species *globulus* set out some ten years ago, and nearly all of these trees show the effects of the ocean winds.

The Sugar Gum is in the largest numbers of any of the Eucalypts around San Diego as a street and shade tree, while there are other trees of the following species: *citriodora*, *cornuta*, *robusta*, and *calophylla*.

The Santa Fé Railroad Company has purchased a ranch at Del Mar, San Diego County, which covers nearly 8,000 acres, which they eventually expect to cover with Eucalyptus trees for ties, bridge timbers, etc., to be used along their roadways and in their coaches. This last spring a start was made on the planting. *Eucalyptus rostrata*, *resinifera*, and *tereticornis* are thought of very favorably by the company.

The company has sent one agent to southern Europe to make a study of the methods employed there in the growing of the Eucalypts commercially, and another has been sent to Australia to make a study of the trees in their native country.

At Charter Oak and San Dimas are found a large number of trees of the species *Eucalyptus citriodora*, *globulus*, *viminialis*, *rostrata*, and *robusta*.

Pomona has many groves of Eucalypts, one of which is situated about four miles southwest and is composed of the following species: *Eucalyptus viminialis*, *rostrata*, *diversicolor*, *resinifera*, and *globulus*.

From Pomona to Riverside there are many groves, wind-breaks and short avenues of *corynocalyx* and *globulus*.

At Riverside on the different drives and streets are to be found the following Eucalypts: *globulus*, *rostrata*, *viminialis*, *punctata*, *robusta*, and *corynocalyx*. There are two specimens of *populifolia* at Arlington.

At Colton the following Eucalypts are found: *robusta*, *globulus*, *viminialis*, and *corynocalyx*.

In San Bernardino the following are growing: *Eucalyptus globulus*, *corynocalyx*, *robusta*, *rostrata*, and *polyanthema*.

At Redlands as street trees and in the Smiley Heights Park are to be found the following: *corynocalyx*, *robusta*, *viminialis*, *ficifolia*, *globulus*, *rostrata*, *sideroxylon*, and *citriodora*.

At Imperial, in the Imperial Valley, there have until the present time been only three species tried that can withstand the heat; these are as follows: *Eucalyptus rostrata*, *tereticornis*, and *rudis*. The common Blue Gum, *globulus*, has succumbed to the heat in every instance where it has been set out in that region.

The following is a list of the different species of Eucalyptus growing on the University of California Forestry Station grounds at Santa Monica:

Eucalyptus amygdalina, *amygdalina* var. *angustifolia*, *Andreana*, *acmenioides*, *botryoides*, *citriodora*, *calophylla*, *cornuta*, *cornuta* var. *Lehmannii*, *corymbosa*, *corynocalyx*, *cosmophylla*, *coriacea*, *cordata*, *dicipiens*, *diversicolor*, *Eugenioides*, *eximia*, *ficifolia*, *globulus*, *goniocalyx*, *gomphocephala*, *Gunnii*, *haemastoma*, *incrassata*, *jugalis*, *leucoxylon*, *longifolia*, *leptophleba*, *largiflorens*, *macrocarpa*, *macrorhyncha*, *marginata*, *McArthurii*, *Mulleriana*, *maculata*, *microcorys*, *megacarpa*, *obcordata*, *obtusifolia*, *occidentalis*, *paniculata*, *pilularis*, *piperita*, *polyanthema*, *platypus*, *punctata*, *populifolia*, *pulverulenta*, *redunca*, *regnans*, *rostrata*, *rudis*, *resinifera*, *robusta*, *resinifera* var. *grandifolia*, *rubida*, *raverentiana*, *siderophloia*, *sideroxylon*, *sideroxylon* var. *rosea*, *Sieberiana*, *Stuartiana*, *salmonophloia*, *stellulata*, *tereticornis*, *viminialis*.

EUCALYPTUS FOR PLANTING IN CALIFORNIA.

Of these many different species of Eucalyptus, the majority of which are unknown save to the specialist, we select the following eighteen for special consideration, as being the most promising for commercial planting in California on the basis of present knowledge. The order of arrangement is simply alphabetical.

EUCALYPTUS BOTRYOIDES. BASTARD MAHOGANY.

(Figures 19, 21, and 22.)

The trees of this species are very erect in growth, but branched; the bark of the trunks of the old trees is reddish brown in color, rough and nearly persistent; the limbs are generally smooth, shedding their bark in long strips.

The leaves are lance-shaped, leathery in texture, in color the upper surface is a dark green, while the lower surface is much paler.

The flower clusters are borne laterally on compressed stalks. The seed cases are five to seven in number, deep, cup-shaped and stemless.

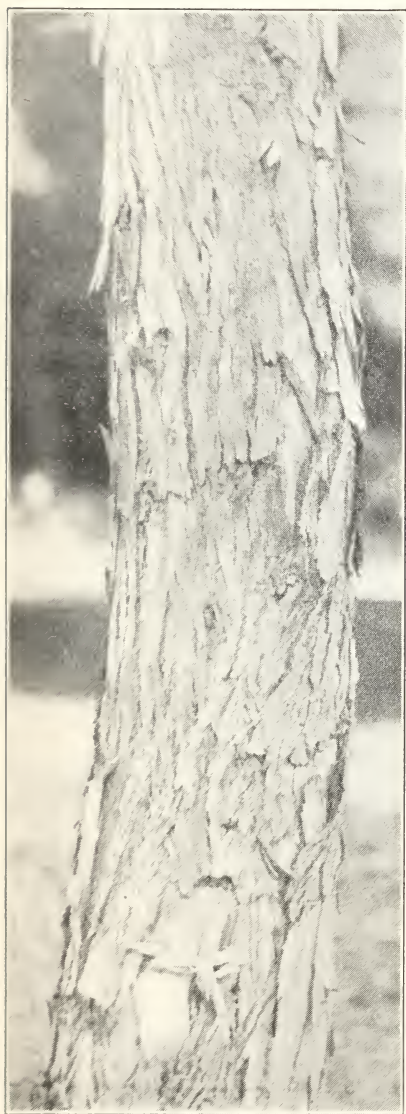


Fig. 19. *Eucalyptus botryoides*.

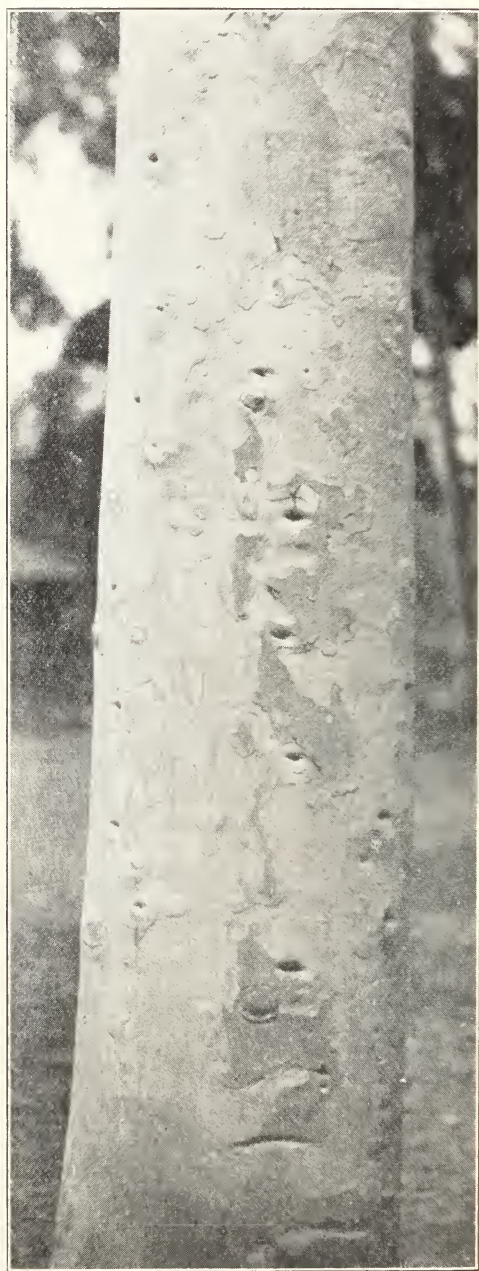


Fig. 20. *Eucalyptus citriodora*.

The timber of this species is considered by the Australian writers to be one of the best of the Eucalypts, when it is grown where there is plenty of water.

This species is growing around Santa Barbara and Montecito, also south along the coast.

The young trees at the Forestry Station, fourteen months old, made



Fig. 21. *Eucalyptus botryoides*.

an average growth of nearly 13 feet, and a tree six years old has a height of 38 feet ten inches and a diameter of $7\frac{1}{2}$ inches.

This species makes the best of wind-breaks and is also one of the best Eucalypts to use as a shade tree.



Fig. 22. *Eucalyptus botryoides*. Natural size.

EUCALYPTUS CITRIODORA. LEMON SCENTED GUM.

(Figures 13 (p. 49), 20 (p. 58), and 23 and 24.)

Eucalyptus citriodora is of an erect habit of growth (see page 49) in protected places, but branches more or less in unprotected situations. This species has a tendency to put out most of its limbs on the windward side. Figure 13 shows a typical specimen of the species standing in an unprotected situation.



Fig. 23. *Eucalyptus citriodora*.

The deciduous bark of the old trees is of a cream color, mixed here and there with dark shades of lavender, due to the unequal flaking off of the bark, which generally occurs in June and July, while the trees are in bloom.

The drooping branches with their long, narrow and slightly curved leaves, which are dark green on both sides, give to the trees a weeping effect. The leaves when crushed give off a very fragrant lemon scented aroma, from which the species derives its name.

The buds with their deciduous calyx caps are nearly egg-shaped, while the mature fruit is nearly spherical, with the valves, four in

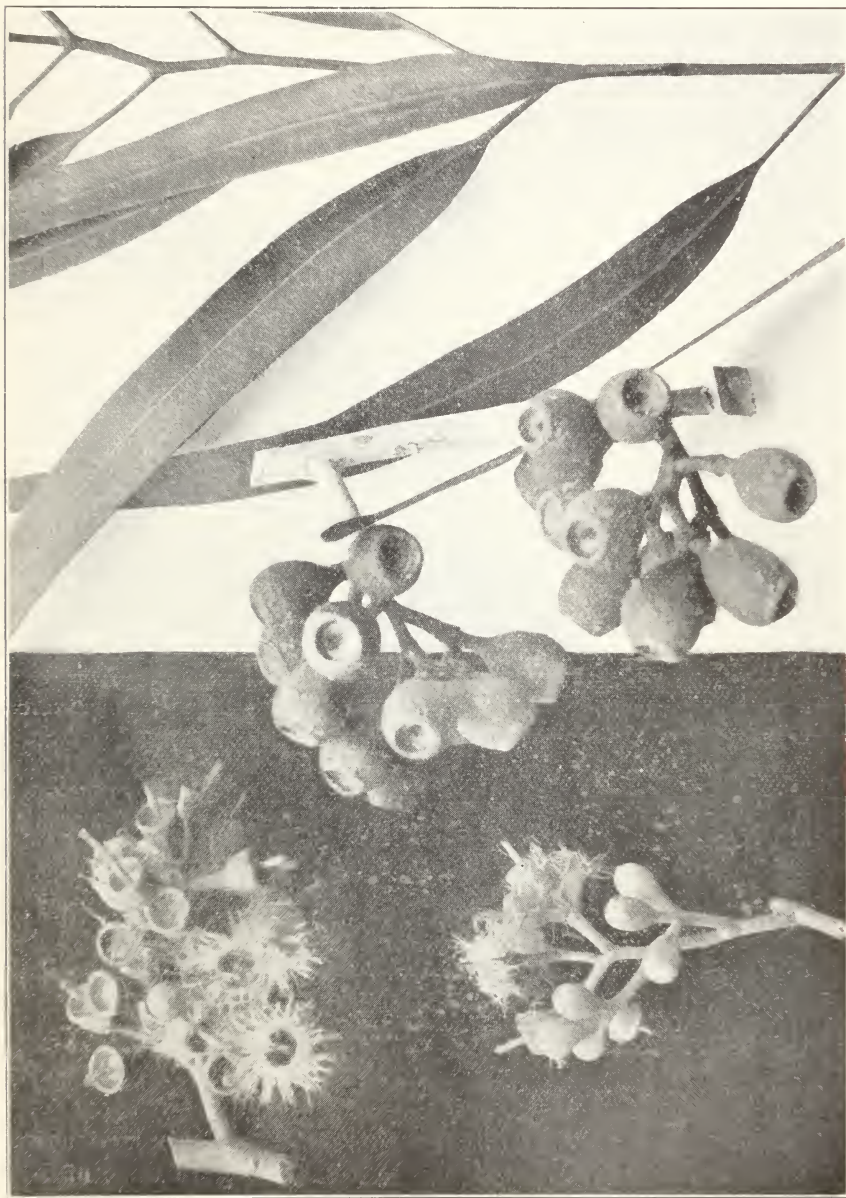


Fig. 24. *Eucalyptus citriodora*. Natural size.

number, enclosed. The seed ripens during the summer months. It is flat in shape, nearly the size of the Blue Gum, but has a yellowish colored center.

The range of this species is limited to the warmer parts of the State, because it is not able to withstand frost. It thrives best along the coast, from Ellwood, Santa Barbara County, to Coronado, San Diego County. Trees of this species can be found in many of the towns, if there are parks or wealthy residents. Some fine specimens are to be found in West Lake Park, Los Angeles; at San Dimas, in the citrus region, a large number of these trees has been set out.

Mr. J. B. Neff, of Anaheim, has two fine specimens of this species, twelve years old, in front of his house; the trees have made a growth of a little over sixty feet.

This species can be grown on any tillable soil, free from alkali, where the temperature does not fall much below 32°F. The average growth per year of trees of this species, for from ten to sixteen years, is between five and six feet. There are, however, a few specimens which have, under irrigation, made a greater growth.

The wood of this species when sawed is light colored, and has a very close grain; it is a wood that undoubtedly can be put to many practical uses, although there are many others of a more rapid growth with as good if not more valuable wood. It is a wood that splits very readily.

EUCALYPTUS CORYMBOSA. BLOODWOOD, N. S. W.

(Figures 25, 27, and 28.)

This species has an erect habit of growth, forming straight poles with but few limbs.

The bark of the old trees is rough, but not deeply furrowed. It is persistent and of a dark gray color. The bark of the limbs is smooth and brown in color.

The leaves are long, lance-shaped, dark green on the upper surface, while the under surface is several shades lighter. The young foliage is very light green in color and waxy. The petioles of the leaves are red in color.

The buds are borne on long stalklets, in clusters of from two to seven, in paniculated umbels. The mature seed cases are somewhat similar in shape to those of the Sugar Gum, but much larger. The valves are deeply enclosed.

The wood of this species varies in color from a brown to a red and is full of gum veins, which make the lumber for building purposes or wagon work valueless. However, it is recommended by the Australian writers as very durable and valuable as piles and ties, especially for work in the water.

If the bark is injured an exudate appears, which is red in color, but soon hardens, forming a very dark colored, resin-like substance.



Fig. 25. *Eucalyptus corymbosa*.



Fig. 26. *Eucalyptus corynocalyx* (p. 66).

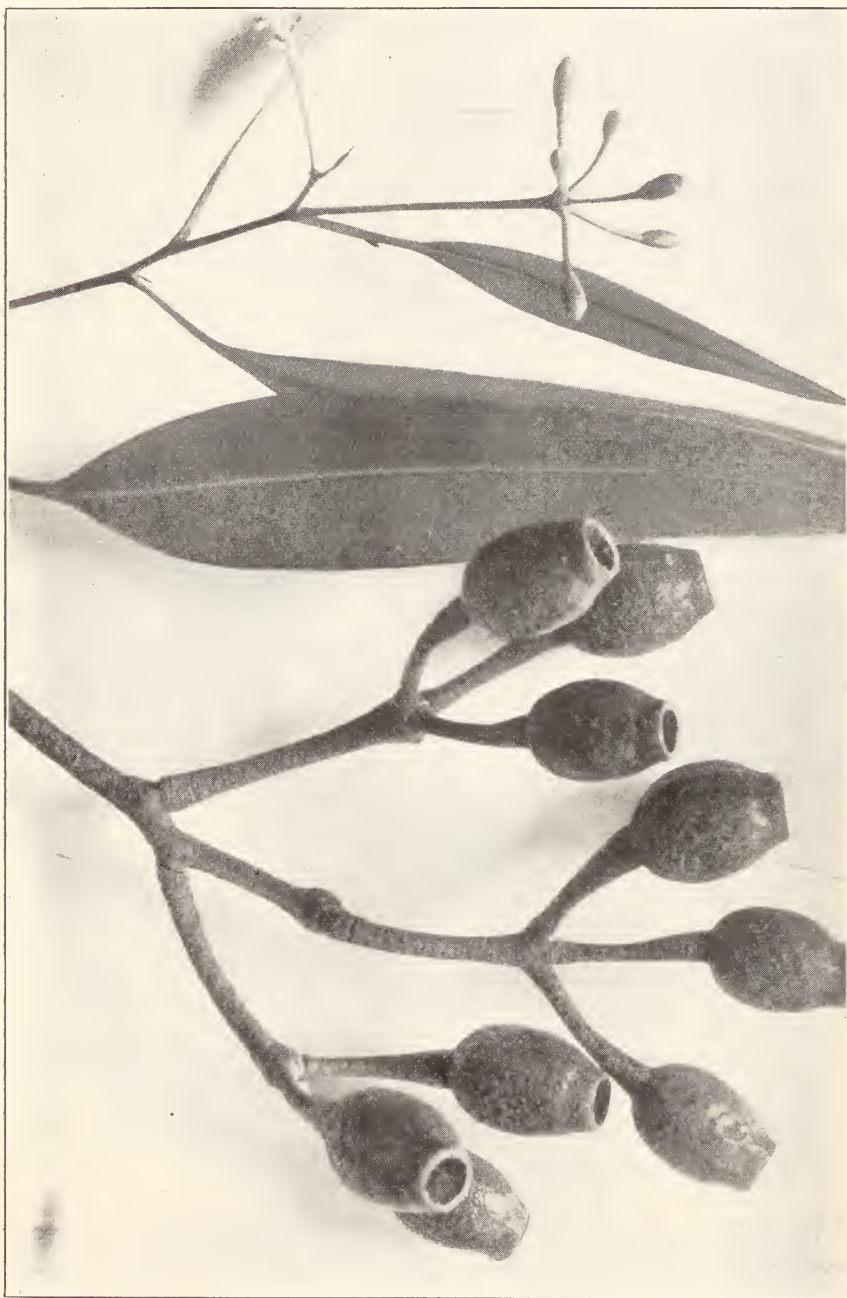


Fig. 27. *Eucalyptus corymbosa*. Natural size.

Trees of this species are growing at Santa Barbara and in that vicinity, also along the coast south of there in a few places. To reach its greatest development it requires a moist locality, where heavy frosts are uncommon.

A tree on the Forestry Station grounds has made a growth of 82½ feet and a diameter of 11½ inches chest high in eighteen years.



Fig. 28. *Eucalyptus corymbosa*.

EUCALYPTUS CORYNOCALYX. SUGAR GUM.

(Figures 26, 29, and 30.)

Trees of this species in close planting grow erect, having a very open crown, while individual specimens branch low, with the branches scattering. The bark of the trunks of the old trees is deciduous, and of a scaly appearance, due to the unequal flaking off at different times of the year. In color it varies from a cream to a dark gray.

The branches are smooth, shading off in color to a light green, while

the twigs, young seedlings and sprouts are of a reddish hue. The leaves of the young plants are ovate, dark green in color on the upper side of the leaf and several shades lighter underneath. Those of the old



Fig 29. *Eucalyptus corynocalyx*.

trees are long, slightly curved and sharply pointed, somewhat leathery in texture, dark green on the upper side and lighter in color beneath.

The buds are borne laterally and bloom during August and September; umbels alternate, solitary, pedicels short, the buds with their deciduous calyx caps are dumb-bell shaped, while the mature fruit is



FIG. 30. *Eucalyptus corynocalyx*. Natural size.



Fig. 31. *Eucalyptus crebra* (p. 72).



Fig. 32. *Eucalyptus diversicolor*.

egg-shaped, with the valves three to four in number, generally three, enclosed. The seed ripens during the summer months and is brown in color and the size of the Blue Gum seed, but not so angular.

The lumber of the Sugar Gum is of a yellowish white color, easy to work when green but very hard if allowed to dry. This wood is very close grained and hard, and tested very high at Berkeley in the tests

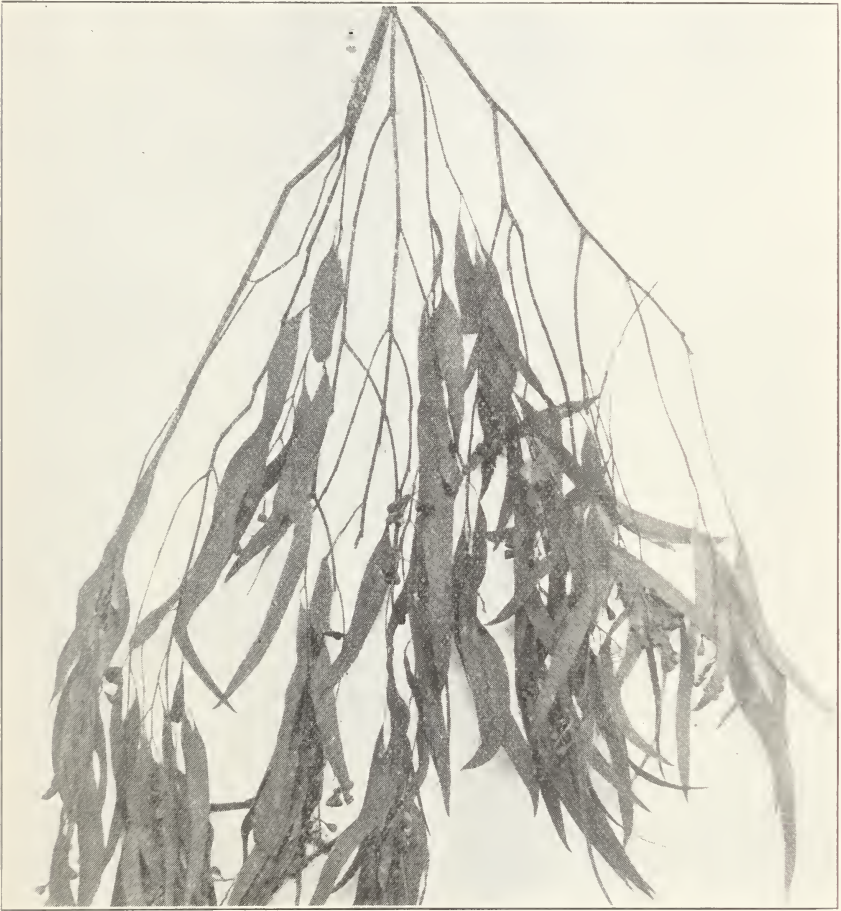


Fig. 33. *Eucalyptus crebra* (p. 72).

carried on by the United States Forestry Service. The wood can be used for the same purpose as the Blue Gum wood, and is durable under ground.

Trees of this species reach their best development in the southern part of the State. The Sugar Gum has been given a thorough trial in both the San Joaquin and Sacramento valleys, but in every case known to the writer they have been killed by frost. Some of the best growths of this tree can be seen at Riverside, or in the towns along the coast from



Fig. 34. *Eucalyptus crebra*. Natural size (p. 72).

San Diego to Santa Monica. This is one of the trees much used in southern California as a street tree, especially at and around San Diego. It is to be found growing as wind-breaks around Riverside, San Bernardino, Colton, Ontario, Pomona, and San Dimas.

This species is one of the most drought resistant and valuable Euca-



Fig. 35. *Eucalyptus diversicolor* (p. 75).

lypts that can be set out commercially, but it succumbs to frost. It is of a much slower growth than the other commercial Eucalypts, coming after *rostrata*, as a rule.

EUCALYPTUS CREBRA.

(Figures 31, 33, and 34) (pp. 69, 70, 71.)

This species is of an erect growth and has a very rough, persistent bark of a light grayish color, the rough bark extending to the limbs and small twigs, which are smooth.

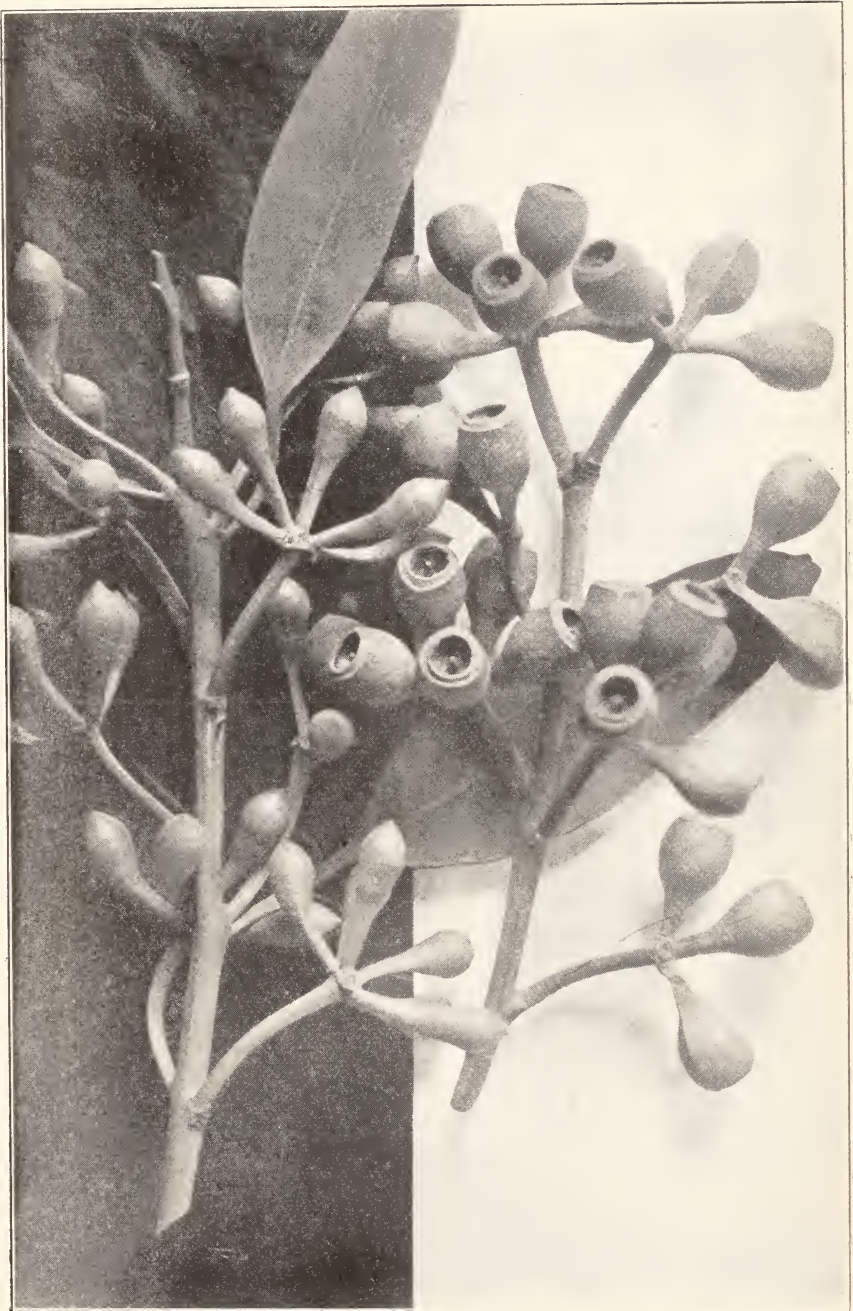


Fig. 36. *Eucalyptus diversicolor*. Natural size (p. 75).

The leaves are long, narrow, equally dark green on both sides and pendulous, giving the trees a weeping effect.

The mature seed cases are borne in paniculated umbels, and are small, cup-shaped, with the valves, generally four in number, enclosed.

The wood is hard, durable and of a reddish color, considered very valuable.



Fig. 37. *Eucalyptus globulus*.

This species has the power to resist frosts and is found growing at Fresno and in the southern part of the State.

It is being set out in great numbers at the present time by companies, in commercial plantings.

In rapidity of growth this species ranks near the *Eucalyptus rostrata*.

EUCALYPTUS DIVERSICOLOR.

(Figures 11 (p. 50), 32, 35, and 36.)

The natural growth of this species is erect, with branched, open crowns; isolated specimens, as well as those in close plantings, have straight trunks suitable for poles. (Fig. 14.)

The bark of the old trees is nearly persistent, only small areas flaking off at irregular intervals of time. The color varies on the same tree from a light to a very dark gray, almost black in some instances.

The leaves are lance-shaped, of medium size, leathery texture, the veins being parallel and at nearly right angles to the mid-vein. In color the upper surface is dark green, while the under surface is several shades lighter.

The buds are borne in solitary axillary umbels in clusters of from four to nine, on one-fourth inch stalklets. The mature seed cases are similar to those of the *Eucalyptus citriodora* and *maculata*, egg-shaped, with the small end cut off; the valves, four in number, are enclosed.

The wood is very hard, durable and of a very light red color. It is valuable as ties, lumber for building purposes, wagon work, and in the manufacturing of furniture, as it takes a fine polish.

This species was set out at Hanford, but it succumbed to the frosts. The Hon. Ellwood Cooper has fine specimens growing at Ellwood, north of Santa Barbara.

The trees on the Forestry Station grounds, set out four years ago, have made a growth of 32 feet in height and $3\frac{1}{2}$ inches in diameter. The eighteen-year-old trees have a growth of 72 feet in height and $14\frac{3}{4}$ inches in diameter. This species makes its greatest growth along the coast, where water is plentiful.

EUCALYPTUS GLOBULUS. BLUE GUM.

(Figures 9, 10, 11, 12 (pp. 43-48), 37 and 38.)

Individuals of this species grow erect as a rule, branching low in isolated specimens, while those in close plantings have small crowns and are practically free from lateral branches. The bark of the seedling is light bluish green in color, while that of the trunks of the old trees varies from a light brown to a gray or greenish color due to the flaking off of the bark in long strips. The limbs are generally smooth.

The stems of the seedlings are rectangular in shape, while their leaves and those of the sprouts of the old trees are opposite, oblong, bluntly pointed, and of a light bluish green color, darker on the upper side of the leaf. Those of the old trees are elongated, sickle-shaped, leathery in texture, and equally dark green on both sides.



Fig. 38. *Eucalyptus globulus*. Natural size.

This species is in bloom from January to May, the flowers being white in color, generally solitary, axillary and borne on short stalks. The whitish buds are angular, with a bluntly pointed-saucer-shaped deciduous cap, while the mature fruit is dark green in color, with from three to five valves, generally four, barely enclosed.

Trees of this species endure the frosts of the Sacramento Valley as far north as Red Bluff, Tehama County, and the dry heat of the San Joaquin Valley. It is found in nearly every town south of San Francisco to San Diego, and out to the edge of the Imperial desert region. A large number of Blue Gum seedlings have been set out in Imperial Valley, but nearly all have died on account of the intense heat, while the trees of the species *rostrata* and *rudis* have survived the heat and are making wonderful growths under irrigation.

The Blue Gum reaches its greatest development along the coast and river bottoms, where the annual rainfall is fifteen or more inches, and foggy days are common; although trees of this species are to be found growing on lands varying from an alkali to a rich loam, and at varying elevations from river bottoms to hilltops. On the east slope of a number of small hills near Santa Monica, Cal., this species volunteers readily from its own seeds.

The lumber of this species is durable above ground, and is being sawed at San José, Cal., for the felloes, poles, reaches and singletrees of wagons, and flooring, insulator pins, and, in fact, anything that requires strength. It is valued at the same price as that of oak lumber, which it is slowly replacing. The wood is yellowish white in color, close grained and easily polished. It has a tendency to chip when planed, on account of a wavy grain.

The leaves from the Blue Gum furnish practically all the Eucalyptus oil in this country, as it is claimed by the distillers that it is the only species producing a sufficient quantity of oil per hundred pounds of leaves to make distilling a profitable business.

This species, *Eucalyptus globulus*, is undoubtedly better known than any of the other Eucalypts in this State, and is recognized generally in the State as one of the fastest growing trees in the world. Following are some of the growths recorded in different localities: Rev. Jewett of Vacaville, Cal., has a grove of 319 trees, set out 8 by 8 feet apart on a medium loam, that are twenty-five years old. The average height is 125 feet and the average diameter is 14 $\frac{1}{4}$ inches chest high.

Mr. Blanchard of Santa Paula, Ventura County, recorded 143 feet in height and 3 to 4 feet in diameter at the base of the trees in a thirty-year-old wind-break that was cut down during the winter of 1906 and 1907. These trees had always been irrigated with the orange grove which they protected from heavy winds.

Mr. Cory of the same place recorded growths of 124 feet in height and 3 feet in diameter at the base of the trees, which were twelve years old when cut on the Limoneira Ranch at Haines, Ventura County. These trees had always been irrigated with the lemons.



Fig. 39. *Eucalyptus leucoxylon*.

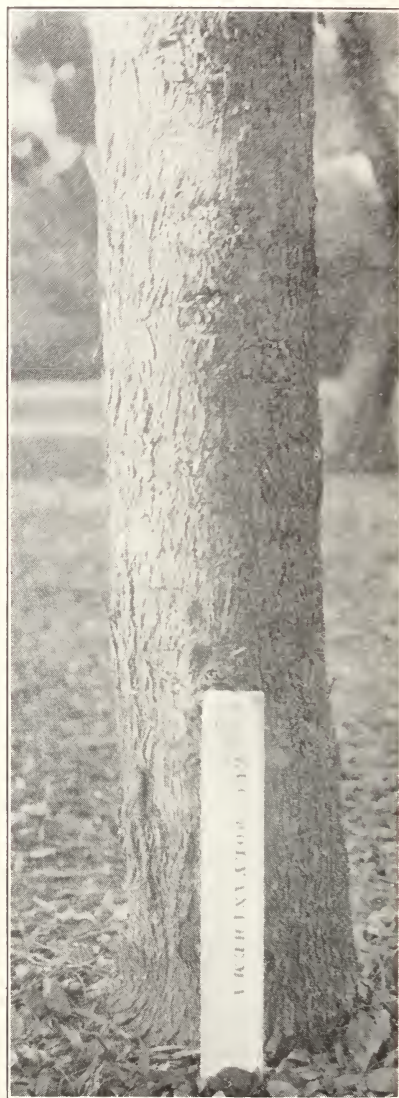


Fig. 50. *Eucalyptus polyanthema* (p. 81).

Mrs. Copely, of Riverside, has a five-acre grove, under irrigation, set out 4 by 8 feet apart, on a sandy soil at Bloomington. They are two years old and have an average height of 25 feet. (Fig. 9.)

We have a one-fourth acre grove on the Forestry Station grounds

at Santa Monica. The trees were set out 4 by 4 feet apart on a mesa two hundred feet above the sea level, and never have received any irrigation except a small can of water per tree when set out. (The rains average nearly twenty inches.) These trees at four and one half years old average over 40 feet, and two of the specimens measure 53½ feet in height, and have a diameter chest high of 7½ inches.



Fig. 41. *Eucalyptus leucoxylon*.

EUCALYPTUS LEUCOXYLON.

(Figures 39, 41, and 42.)

The trees of this species grow branched and out of shape, both in isolated specimens and close planting. In individual specimens they are very ornamental.



Fig. 42. *Eucalyptus leucoxydon*. Natural size.

The deciduous bark of the trunks of the old trees varies from a cream to a very dark gray, in some instances a brownish color. The bark is generally smooth, flaking off in irregular strips.

The leaves of the young plants and the sprouts of the old trees are opposite, while those of the old trees are long, narrow and slightly curved, equally dark green on both sides.

The buds are nearly spherical and beaked, borne in solitary, axillary umbels, in clusters of from two to four, generally three, on long stalks. The trees are in bloom during the late spring and fall of the year.

The mature seed cases are goblet-shaped, with the valves, generally five in number, deeply enclosed.

The wood of this species saws easily when green. It is light colored, strong, fairly durable and undoubtedly can be used in carpentry and wagon work.

There is a variety of this species, *Eucalyptus leucoxylon* var. *rosea*, which has been recognized of late as a promising ornamental; it has a pinkish bloom and a cream colored bark.

This species reaches its greatest development along the coast in localities where there is plenty of rain, but will withstand drought conditions and low temperatures. It makes a favorable growth, compared to many of the others. Young plants 14 inches in height, set out in March, 1906, averaged in height on June 20, 1907, 8 feet 9 inches; while trees eighteen years old averaged 60 feet in height and had an average diameter of 15 inches.

This tree sprouts very readily after cutting, and in many instances natural seedlings have been found.

EUCALYPTUS POLYANTHEMA. AUSTRALIAN BEECH.

(Figures 40, 43, and 44.)

The trees of this species are generally of a much branched and irregular growth, although in some cases erect growing trees are found.

The bark of the trunks of the old trees is slightly rough, fibrous, persistent and of a light gray color. The branches are generally smooth, varying from a greenish to a bluish white color at the tips of the twigs.

The leaves of the young plants are oval in shape and of a bluish white color, while those of the old trees vary from oval to lance-shape, and in color they are bluish green on both sides.

The umbels are paniculated and the whitish buds are borne on stalklets of medium length, in clusters of from four to seven. The mature seed cases are very similar to those of the *Eucalyptus crebra*,

goblet-shaped and small, with the valves, from three to five in number, generally four, enclosed.

The wood of this species is of a light color, hard, and easily polished. It is said by Australian writers to be durable.

This tree is drought-resistant and one that can be grown on the dry



Fig. 43. *Eucalyptus polyanthema*.

mesa land in the southern part of the State, where heavy frosts are uncommon.

The growth of this species is very slow in comparison with some of the others of the family. Ten-year-old trees on the Forestry Station grounds, on a mesa without water, made the following growth: average height, $36\frac{1}{2}$ feet, diameter chest high, $5\frac{3}{4}$ inches. This species is growing as wind-breaks near Piru, Ventura County, also as orna-

mentals, wind-breaks, and for fuel in the vicinity of Los Angeles, and south along the coast.

EUCALYPTUS PUNCTATA. LEATHER JACKET.

(Figures 45, 47, and 48.)

The trunks of this species are erect in growth, both in isolated specimens in close planting. The bark of the trunks of the young trees



Fig. 44. *Eucalyptus polyanthema*. Natural size.

is smooth and of a reddish brown color, while that of the old trees is a dark grayish brown, changing to a light brown directly after the old bark flakes off, which generally is only in small areas at different times of the year.

The buds are borne in clusters of from five to seven, on short stems; the umbels are solitary and axillary; this gum is in bloom during



Fig. 45. *Eucalyptus punctata*.



Fig. 46. *Eucalyptus resinifera* (p. 87).

August, September and October. The deciduous calyx cap is sharply pointed, while the mature seed cases are goblet-shaped, with the valves, four and five in number, barely enclosed.

The leaves are of medium length and width, dark green on the



Fig. 47. *Eucalyptus punctata*.

upper surface, with a pale lower surface; the veins are similarly placed to those of *Eucalyptus resinifera*.

The wood is of a light brown color, very hard and durable; valuable in wagon work, carpentry, as ties, posts, and fuel. The wood is very hard to saw when dry, but comparatively easy when green.

Trees of *Eucalyptus punctata* are making a good growth on the Forestry Station grounds at Santa Monica, and at Riverside.

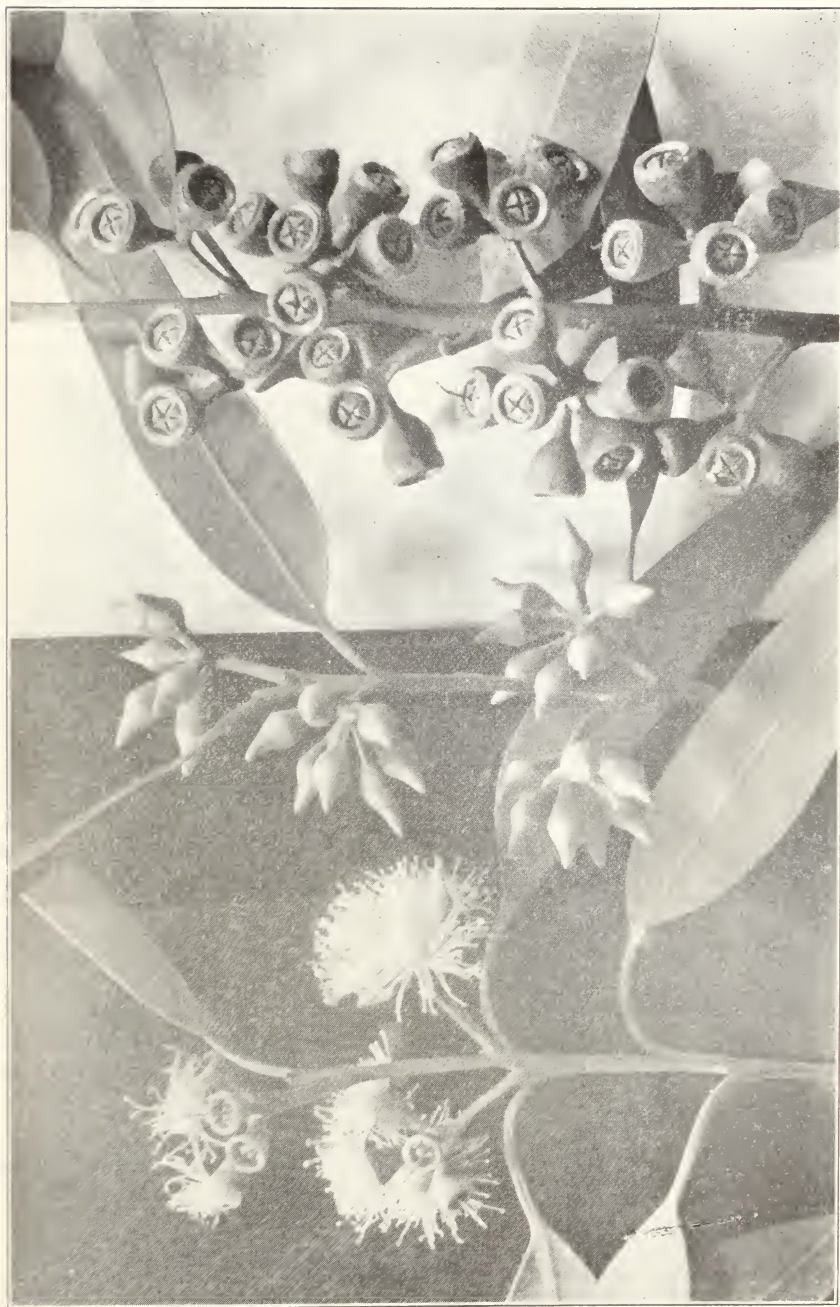


Fig. 48. *Eucalyptus punctata*, Natural size.

This species has failed to withstand the cold weather of the San Joaquin Valley at Hanford, Cal., where it was tested by the Experimental Forestry Company.

EUCALYPTUS RESINIFERA. RED MAHOGANY.

(Figures 46, 49, and 50.)

The trees of this species are the most erect growing of the *Eucalyptus* family. A grove of *Eucalyptus resinifera* always causes people to



Fig. 49. *Eucalyptus resinifera*.

stop and wonder at the erectness and uniformity of growth. The bark of the young trees is a reddish brown, changing to a light gray, mixed with brown in the old trees; it is rough, fibrous, or stringy, and persistent.

The leaves are of medium length and width, slightly curved, of a leathery texture, dark green on the upper side and several shades lighter on the under surface.



Fig. 50. *Eucalyptus resinifera*. Natural size.



Fig. 51. *Eucalyptus robusta* (p. 92).



Fig. 52. *Eucalyptus rostrata* (p. 92).

The buds with their long, conical, deciduous calyx caps are borne in clusters of from five to seven, on short angular stalklets. The solitary umbels are axillary and borne on slightly compressed stalks. The mature seed cases are goblet-shaped, with the valves, three and four in number, protruding.

The wood of this species is of a reddish brown color, varying somewhat. It is very hard, but easily worked, and is capable of taking



Fig. 53. *Eucalyptus robusta* (p. 92).

a high polish. The wood is recommended by Australian writers for ties and other uses in the soil; also for carpentry, shipbuilding, etc.

This tree can endure low temperatures as well, if not better, than the Blue Gum. A few young trees are growing at Hanford. There are also one or two trees at Berkeley on the University campus.

At Santa Monica, on the dry mesa near Port Los Angeles, this species has made a growth in the last five years that compares very favorably with that of the foremost species.



Fig. 54. *Eucalyptus robusta*. Natural size.

EUCALYPTUS ROBUSTA. SWAMP MAHOGANY.

(Figures 51, 53, and 54.)

The swamp mahogany is one of the erect, but slow growing Eucalypts. The trunks of the young trees are of a reddish gray color, slightly rough or stringy, while the limbs are smooth and dull red. The bark of the old trees is very rough, stringy and persistent.

The leaves are of a leathery texture, broad and lance-shaped, with the veins parallel and nearly at right angles to the mid-rib; in color they are dark green on the upper surface, while the under surface is several shades lighter.

The buds, with their deciduous calyx caps, are club-shaped and are borne in clusters of five to eleven. These clusters, or umbels, are axillary and their stalks are flattened. The mature seed cases are deep cup-shaped, with the valves enclosed.

The wood is not very valuable to work, as it is very brittle, but it is durable in the soil. The trees, if grown in a place exposed to the wind, are liable to break off when they have reached a height of from 15 to 30 feet.

Eucalyptus robusta is much used for street planting, and makes one of the best street trees to be found among the species of Eucalyptus, except for its tendency to break down.

It will withstand low temperatures, and is found growing at Hanford, in the San Joaquin Valley; also at Fresno and in groves at Santa Barbara on the coast, where the following growths were recorded: Trees twelve years old had an average height of 45 feet and diameter of $7\frac{1}{2}$ inches, while another grove sixteen years old had an average height of 65 feet and diameter of $8\frac{1}{2}$ inches.

This species is to be found growing all through the southern part of the State along the coast to San Diego; in the latter locality its growth is an inferior one. It reaches its greatest development where there is plenty of water, as in river bottoms, swamps and depressions in fields where the winter rains settle.

EUCALYPTUS ROSTRATA. RED GUM.

(Figures 15 (p. 51), 52, 55, and 56.)

Trees of this species are of a slower growth than the Blue Gum and grow very crookedly even in close plantings.

The bark of the seedlings and the twigs of the old trees have a reddish hue, while that of the trunks of the mature trees is a very dark gray, varying from smooth and non-persistent in some trees to others where it is deeply furrowed and persistent. The limbs are much lighter than the trunk and smoother.

The leaves of the seedlings are broad lance-shaped, darker in color on the upper side, while those of the older trees are elongated, narrow, sickle-shaped, and equally green on both sides. The umbels are solitary and axillary. The flowers are borne in clusters of from three to fourteen, generally seven, on one-fourth inch pedicels.



Fig. 55. *Eucalyptus rostrata*.

The buds, with their hemispherical, sharply pointed lids, are nearly round and a little larger than a BB shot, valves three to five in number, generally four, very much protruding on the mature fruits.

The wood of the red gum is very durable both above and below ground and can be easily worked when green. It is possible to saw the

wood up into the thinnest of lumber and veneers. In color the wood varies from a very light to a dark blood red. This is very heavy and takes a fine polish, but according to the strength tests it is inferior to both Sugar and Blue Gums.

The present range of *Eucalyptus rostrata* extends south from Chico, Butte County, in the Sacramento Valley, throughout the San Joaquin Valley, into the southern part of the State, and this species has shown its ability to stand the intense heat of Imperial Valley throughout its entire length to Calexico, on the Mexican border.

The Red Gum makes a good growth on alkali soils in the San Joaquin Valley and withstands the extremes of temperature of that region. It withstands frosts better than *Eucalyptus globulus*, although its present range is smaller than that of the latter species. Undoubtedly the reason of its range being smaller than that of the Blue Gum is due to its more recent introduction into this country.

The Red Gum is one of our most drought resistant trees of any commercial value, other than the Sugar Gum. It is a slow growing species in regard to height, but one of the first in regard to diameter growth.

Mr. A. Burns, of Batavia, Cal. (in the lower part of the Sacramento Valley), has one of the oldest groves of the Red Gum in the State. The grove is twenty-two years old, set out 6 by 6 feet apart, on a rich soil; the average height is 80 feet, with an average diameter of 11½ inches chest high. (Fig. 15.)

The Experimental Forestry Company, of Hanford, Cal., have a young grove of this species, set out 5 by 5 feet apart, on a slightly alkali soil. All of the trees are growing well and have withstood the frost better than the Blue Gums which are planted beside them.

Mr. Whiting of El Centro, Imperial Valley country, has a two-year-old grove of nearly one-half acre set in rows, but of no measured distance, ranging from three to eight feet apart; these trees have received irrigation ever since they were set out and their average height is 25 feet, with an average diameter of a little over 3 inches chest high.

Mr. Whiting also has a row of trees belonging to the same species four years old, growing on the bank of an irrigating ditch which always has water in it. The largest tree in the row measures in diameter 9¼ inches chest high, with a height of a little over 30 feet.

In every instance where this tree was found in the Imperial Valley it was making a good growth, with the proper care, and withstanding the heat. In one row of trees along an irrigating ditch, originally there had been set out the Red Gum and Blue Gum together; the *rostrata* averaged in diameter, chest high, 7 inches at four years old, while all that remained to show that there ever had been any Blue Gum set out were a few dead stems.



Fig. 56. *Eucalyptus rostrata*. Natural size.

EUCALYPTUS RUDIS.

(Figures 16 (p. 52) and 57.)

Trees of this species are erect, branching low in individual specimens, but having clean trunks in close plantings.

The bark of the trunks is persistent, slightly rough, but not deeply furrowed; in color it is gray.

The leaves of the young plants are oval and of a purple hue, while those of the old trees vary, oval to lance-shaped.

The buds, with their blunt, cone-shaped deciduous calyx caps, are borne on medium length stalklets, in clusters of from five to nine. The solitary umbels are axillary.

The mature seed cases are broad cup-shaped, with the valves, from four to six in number slightly protruding.

There are two different trees in the State recognized as *Eucalyptus rudis*: the tree called *rudis local* in the southern part of the State has a smooth-barked trunk, as a rule, and the wood is inferior, dark brown in color and light.

The species described grows in the vicinity of Fresno and is a superior tree, with wood of a light brown color, hard and easily polished. (Fig. 16.)

The wood of this latter tree is very durable; Mrs. Sherman, of Fresno, has records of posts standing in the ground for eleven years without signs of decay. This tree has volunteered freely around Mrs. Sherman's home.

Eucalyptus rudis is capable of enduring low temperatures, as well as *globulus*.

EUCALYPTUS SIDEROPHLOIA. BROAD LEAFED IRONBARK.

(Figures 17 (p. 54), 58, 60, and 61.)

This ironbark grows erect, straight trunks with small crowns both in isolated specimens and in close plantings. The bark of the trunk of the old trees is similar in appearance to the southern pine: rough, dark brown in color, and persistent, while that of the young trees and the limbs of the old trees is light brown and smooth.

The leaves of the old trees are long, broader at the base than the average *Eucalyptus* leaf, slightly curved and of a leathery texture, while those of the young seedlings are very broad at the base, short, and of a greenish blue color.

The buds, with their long horn-shaped calyx cap, are borne in paniculated umbels in clusters of from five to eleven; the mature seed cases are top-shaped, with the valves, four in number, protruding.

The wood of this species is yellowish white in color, strong and dura-

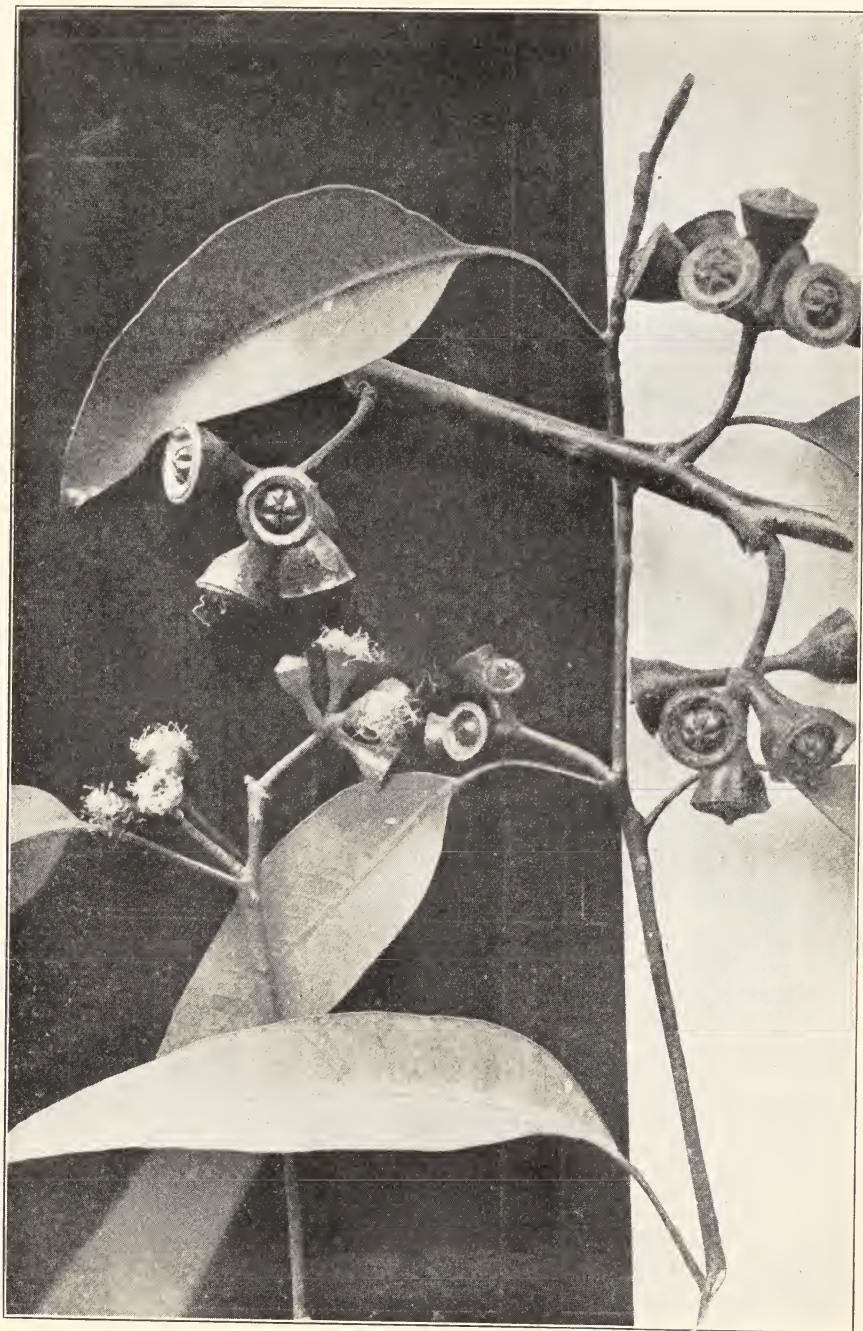


Fig. 57. *Eucalyptus rudis*. Natural size.

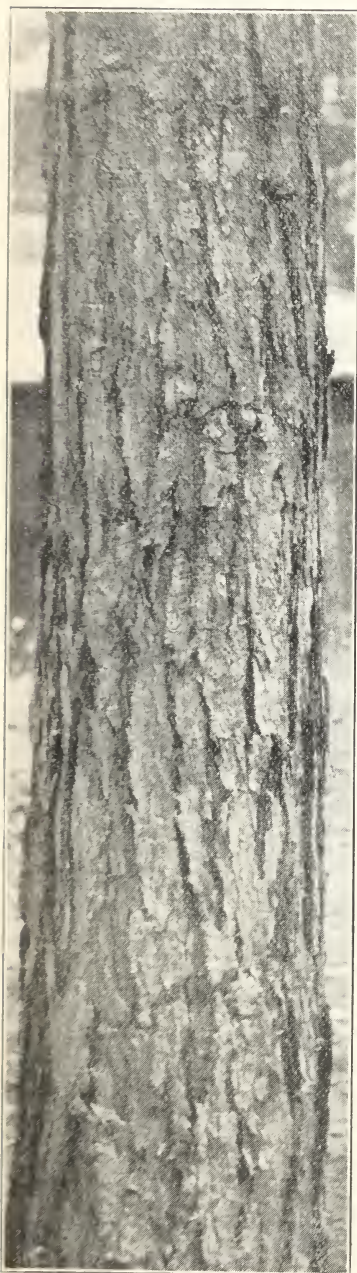


Fig. 58. *Eucalyptus siderophloia*.

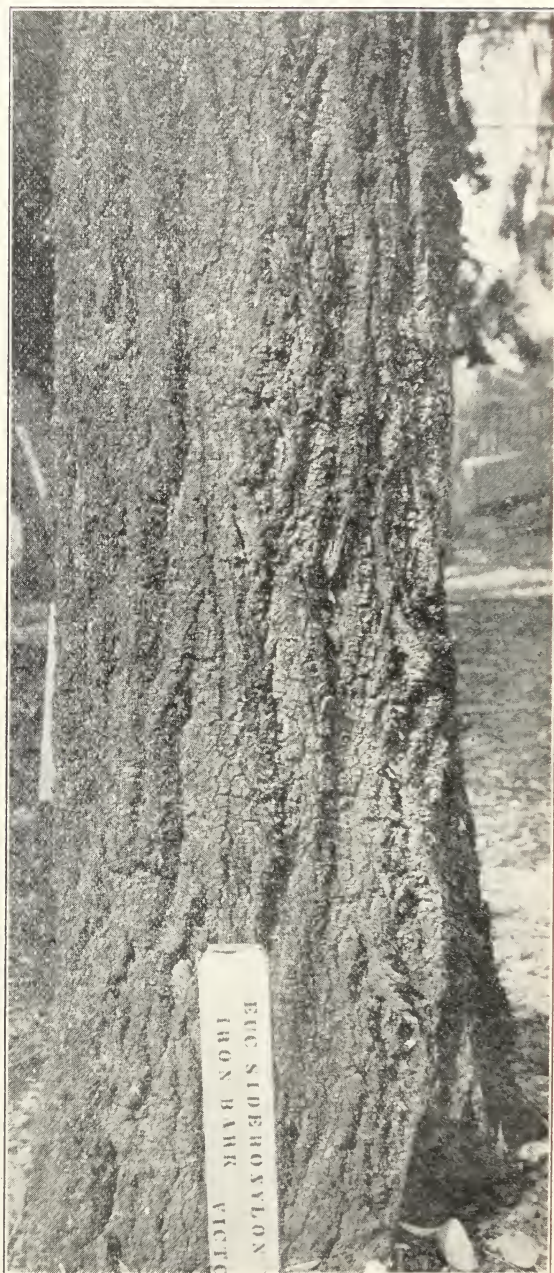


Fig. 59. *Eucalyptus sideroxylon* var. *rosea*.

ble. It can undoubtedly be used for building, wagon work, posts and poles.

In rapidity of growth and resistance to extremes of temperature, it ranks very favorably with *Eucalyptus rostrata* and *Eu. tereticornis*.



Fig. 60. *Eucalyptus siderophloia*.

The present range of this species is small, due primarily to the fact that its commercial value has been little known till recently. It has proven itself capable of withstanding the frosts and heat of the San Joaquin Valley at Hanford.



Fig. 61. *Eucalyptus siderophloia*. Natural size.

Two trees of this species on the Forestry Station grounds, nearly twenty years old, measure 75 feet in height and have diameters chest high of over a foot.



Fig. 62. *Eucalyptus sideroxyylon* var. *rosea*.

EUCALYPTUS SIDEROXYLON VAR. ROSEA. VICTORIA IRONBARK.

(Figures 17 (p. 53), 59, 62, and 63.)

This variety has made fair growths in a number of localities in California. It has a tendency to grow crooked and branched. The black bark is deeply furrowed and persistent, giving to the trees a burned appearance, which is characteristic of this variety.

The foliage of the tree is beautiful, of a bluish tint and pendulous, producing a weeping effect. The leaves are of medium width and length, of light bluish green color.



Fig. 63. *Eucalyptus sideroxylon* var. *rosea*. Natural size.



Fig. 64. *Eucalyptus tereticornis* (p. 106).



Fig. 65. *Eucalyptus viminalis* (p. 106).

The buds are borne in solitary axillary umbels, in clusters of generally seven on one-fourth inch stalklets. In shape they are cylindrical, with a conical calyx cap. The flowers pinkish in color and in bloom from March to June.

The mature seed cases are deep cup-shaped, with the rim compressed, and the valves, which vary from four to six, deeply enclosed.



Fig. 66. *Eucalyptus tereticornis*.

The wood of this species is of a dark brown color and particularly hard, heavy and durable.

The largest grove of this variety of *Eucalyptus* is at Garden Grove, Cal. The trees are twenty-six years old and vary in size from six inches to over one foot in diameter while in height one is nearly 100 feet, although the average is near to 80 feet. (Fig. 17.)

One of the old trees on the Forestry Station grounds eighteen years old measures $54\frac{1}{4}$ feet in height with a diameter of 20 inches chest high.



Fig. 67. *Eucalyptus tereticornis*. Natural size.

EUCALYPTUS TERETICORNIS. FOREST GRAY GUM.

(Figures 64, 66, and 67.)

This species is of a very erect habit of growth, both in close plantings and isolated specimens. The branches are few and scattering, leaving the crown open. The deciduous bark of the trunks of the old trees is generally smooth and of a mottled color, from light brown to cream, directly after the bark has been shed.

The buds are in bloom during May and June, and are borne laterally in solitary umbels, in clusters of from five to nine, on short stalklets. The deciduous lid is horn-shaped; reddish brown in color, just before blooming time.

The seed cases are slightly larger than those of *Eucalyptus rostrata*; with the valves, three to five in number, generally four, protruding and hemispherical.

The leaves of the young plants are broad lance-shaped, while those of the old trees are long, of medium width and light green on both sides. The pendulous branches with their long leaves give to the trees a weeping effect.

The wood of this species is close grained and durable, varying in color from a white to a light brownish red, and can be used in wheelwrights' work, etc.

The Forest Gray Gum's range is small at the present time, primarily because of its value only coming to light recently. The Hon. Ellwood Cooper has the largest number of old trees of this species in the State at the present time, although this past spring there has been a large acreage of young trees set out in different parts of the State.

The Experimental Forestry Company, of Hanford, Cal., has a grove two years old, which has made a more rapid growth than *Eucalyptus rostrata*, and has withstood the heat and frosts fully as well if not better than the latter species.

Undoubtedly *Eu. tereticornis* can withstand as wide a range of temperature and variation in soils, over as large a range of the State as the Red Gum.

EUCALYPTUS VIMINALIS. MANNA GUM.

(Figures 18 (p. 54), 65, 68, and 69.)

There are two varieties of this species, both erect growing trees. The trunks of one variety have a bark not dissimilar to that of *Eucalyptus globulus*, while that of the other has a smooth bark, white in color and deciduous. The bark is shed each year just as the trees are entering the blooming period.

The leaves of the young plants and the sprouts of the old trees are

from two to three inches long, narrow and opposite; while those of the old trees are long, narrow, slightly curved, of a dull green color, pointed and pendulous, giving to the trees a weeping effect.

The stemless buds, with their conical, deciduous calyx cap, are borne in threes, on slightly flattened stalks. The mature seed cases are goblet-shaped, with the valves, four in number, barely protruding.

The wood of the species is inferior to that of the Red Gum, both in strength and durability, although it is useful in rough carpentry and



Fig. 68. *Eucalyptus viminalis*.

in making fruit boxes, or any other light shipping boxes. In color the sap wood is light brown, changing to a yellowish white in the older wood.

The Manna Gum withstands low temperatures equally as well as the Red Gum or the Blue Gum, and is growing at Chico, Butte County, in greater numbers than any other *Eucalyptus*. This species, with the Blue Gum, forms the bulk of all the plantings north of San Francisco.

Mr. B. F. Walton, of Yuba City, has a grove of *Eucalyptus viminalis*,



Fig. 69. *Eucalyptus viminalis*. Natural size.

thirty years old, with many trees over 3 feet in diameter chest high, and over 80 feet in height.

There are many specimen trees in the State that have made larger growths than the above mentioned trees, as this gum ranks next to the Blue Gum in rapidity of growth.

Although this species is not a very valuable timber tree, it makes an average wood for fuel purposes and can be grown on land and under conditions where many of the other and more valuable species would barely live and make only an inferior growth.

COMMERCIAL CONSIDERATIONS FOR PRESENT PLANTING.

The most prominent commercial species of *Eucalyptus* in California at present are four: *globulus*, *corynocalyx*, *tereticornis*, and *rostrata*. Of these four *tereticornis* and *rostrata* have been set out in large numbers during the past year. The wood of each is durable in the soil and of varying shades of red in color, but inferior in strength to either of the other two species. On account of the supposed very dark color of the wood these two are being set out for the purpose of growing finish lumber. As a matter of fact most of the lumber of either of these species will have to be stained to use it for interior finish, and the question arises if it would not be more profitable to plant the faster growing species, *globulus*, provided it is adapted to the region where the planting is to be made. *Eucalyptus globulus* has such remarkable all-round qualities as compared with the other species tested in California as to make its exclusive planting for timber purposes worthy of serious consideration in all regions where it grows to advantage. Its combination of rapidity of growth, straightness of trunk, great strength of wood and its known ability to flourish over a wide range of conditions in California, give it a great advantage over any other species. It is a stronger wood than *rostrata* or *tereticornis*, yellowish white in color, with a very good grain in most cases, and is easily stained. It can be used in many places where a colored wood could not and in all places where the colored lumber could be used. If, then, it is simply an issue of staining one wood more than another the superiority of *globulus* in other respects should cause it to be selected as the principal species for planting. It is not durable in the soil, so that for telephone poles *tereticornis* or the straight growing *corynocalyx* may be chosen for localities where they are adapted, while for railroad ties the same species or *rostrata* may be used. *Tereticornis* and *rostrata* have a much wider range of growth in the State than the Sugar Gum.

Prospective planters are particularly enjoined to use caution in selecting species of *Eucalyptus* on the basis of their reported behavior in Australia or other distant regions. The limited plantings now exist-

ing this State are sufficient to show that some of the species most highly recommended in Australia do not behave in the same manner in California. It is therefore better for the planter to stick to those kinds which have shown the most good qualities under our conditions than to experiment too largely with new species.

EUCALYPTS ADAPTED TO SPECIAL PURPOSES.

The Species Whose Wood is the Most Durable in the Soil.

Eucalyptus rostrata, *tereticornis*, *rudis*, *diversicolor*, *sideroxylon* var. *rosea*, *corynocalyx*, *citriodora*, and *crebra*.

The Lumber Species.

All of the species described herein are valuable as lumber trees, although the four following are considered the best among the Eucalypts as commercial lumber trees: *Eucalyptus globulus*, *rostrata*, *tereticornis*, and *corynocalyx*.

The Species for Fuel Alone.

All of the species are of more or less value for wood, but the following two species will produce more wood than any of the others on any good land. These two are the common Blue Gum, *Eucalyptus globulus*, and *viminialis*, the two most rapid growing gums we have in this country.

The Most Frost-resistant Species.

Eucalyptus rostrata, *globulus*, *viminialis*, *tereticornis*, *sideroxylon*, *crebra*, *rudis*, *robusta*, *resinifera*, and *Stuartiana*.

Drought-resistant Species.

Eucalyptus corynocalyx, *microtheca*, *polyanthema*, and *cornuta*.

THE EUCALYPTS AS BEE PASTURE.

All of the Eucalypts have more or less value as bee pasture when in bloom, and from the large number of species growing in the State it is possible to select a group that will furnish bloom for the bees to work on the year round. If the natural pastures are good for all but a short period each year, it is possible to select one or two species of Eucalyptus that will fill in that time.

The list given below is made up from the data collected from two years' observation of the blooming periods of the Eucalyptus species on the Forestry Station ground. The names of the species are put down for the months when the most of the trees of that species are in bloom, although there are instances in every species where some one individual specimen will be found blooming at an entirely different period, or perhaps twice during the year. Some of the species have been considered injurious to bees, but we have never been able to find dead bees under the trees. The bees seem to have a preference for the white or greenish white flowers.

January: *globulus*, *leucoxyton*, *siderophloia*, *robusta*, and *melliodora*.

February: *globulus*, *robusta*, *polyanthema*, *leucoxyton*, and *melliodora*.

March: *globulus*, *robusta*, *leucoxyton*, *polyanthema*, *melliodora*, and *sideroxyton* var. *rosea*.

April: *leucoxyton*, *melliodora*, *Gunnii*, *polyanthema*, and *Stuartiana*.

May: *melliodora*, *Gunnii*, *maculata*, *cornuta*, *rostrata*, and *tereticornis*.

June: *melliodora*, *maculata*, *cornuta*, *tereticornis*, *rostrata*, and *citriodora*.

July: *citriodora*, *tereticornis*, *rostrata*, *viminalis*, *cornuta*, and *eugenioides*.

August: *viminalis*, *cornuta*, *Lehmannii*, *eugenioides*, *calophylla*, *corynocalyx*, and *resinifera*.

September: *Lehmannii*, *corynocalyx*, *calophylla*, and *resinifera*.

October: *calophylla*, *corynocalyx*, and *siderophloia*.

November: *corynocalyx*, *siderophloia*, *leucoxyton*, and *robusta*.

December: *globulus*, *robusta*, *leucoxyton*, and *sideroxyton* var. *rosea*.

STRENGTH TESTS OF EUCALYPTUS.

We reproduce the following, bearing on the strength of several species of *Eucalyptus* timber:

UNITED STATES DEPARTMENT OF AGRICULTURE, FOREST SERVICE.

Trade Bulletin 8.

EUCALYPTS FOR TIMBER.

October 8, 1906.

The wood of the *Eucalypts* has not been extensively used by manufacturers in the United States, because the supply has not been sufficient to establish a market. Blue gum, the most common species in California, has, however, competed with black locust for insulator pins, has given satisfactory service in chisel and hammer handles, and has been used locally for wagon tongues, axles, spokes, hubs, and felloes. It is hard, strong, and tough.

In coöperation with the State of California, the Forest Service recently completed a study of the mechanical and physical properties of the common *Eucalypts*. The tests, made at the State University at Berkeley, were to determine whether *Eucalyptus* can be substituted for some of the hardwoods that are becoming difficult to obtain.

Blue Gum is by far the fastest growing species. The height and diameter of trees from which the test pieces were taken is given in the following table. All the trees were about fifteen years old:

SPECIES.		Diameter, Inches.	Height, Feet.
COMMON NAME.	Botanical Name.		
Blue Gum	<i>Eucalyptus globulus</i>	30	101
Sugar Gum	<i>Eucalyptus corynocalyx</i>	15	73
Karri	<i>Eucalyptus diversicolor</i>	16	72
Manna Gum	<i>Eucalyptus viminalis</i>	12	60
Red Gum	<i>Eucalyptus rostrata</i>	9	47
Leather-jacket	<i>Eucalyptus punctata</i>	10	43
Red Mahogany	<i>Eucalyptus resinifera</i>	8	38

An important point in considering the value of commercial plantations of Eucalypts is brought out in the second table, which shows that the fastest growing species are also the strongest. The tests were made upon kiln-dry material.

Species.	Bending.			Compression Parallel to Grain.	
	Age in Years.	Number of Tests.	Modulus of Rupture, Pounds per Square Inch.	Number of Tests.	Crushing Strength, Pounds per Square Inch
Sugar Gum	15	5	25,344	11	11,290
Blue Gum	30	12	23,265	15	12,310
Leather-jacket	15	3	19,267	10	10,908
Karri	15	8	18,386	17	8,795
Blue Gum	15	28	16,900	34	8,190
Red Mahogany	15	4	14,550	2	7,920
Red Gum	15	9	14,380	6	7,723
Manna Gum	15	12	13,093	20	7,309

A comparison with Forest Service tests on hickory shows that 30-year-old Blue Gum is stronger than XXX hickory, and that 15-year-old Sugar Gum is nearly as strong as black hickory and 91 per cent as strong as second-growth hickory.

The wood of very young and sappy trees is apt to warp, but that from more mature growth can be easily handled to prevent warping. Early seasoning should proceed slowly. Open piling is desirable; the stacks should be high to secure weight, and should be covered.

Several of the Eucalyptus grow rapidly in California, and, under forest conditions, form straight, tall poles free from branches. They have, therefore, especial value as timber trees.

STATION PUBLICATIONS AVAILABLE FOR DISTRIBUTION.

REPORTS.

- 1896. Report of the Viticultural Work during the seasons 1887-93, with data regarding the Vintages of 1894-95.
- 1897. Resistant Vines, their Selection, Adaptation, and Grafting. Appendix to Viticultural Report for 1896.
- 1898. Partial Report of Work of Agricultural Experiment Station for the years 1895-96 and 1896-97.
- 1900. Report of the Agricultural Experiment Station for the year 1897-98.
- 1902. Report of the Agricultural Experiment Station for 1898-1901.
- 1903. Report of the Agricultural Experiment Station for 1901-1903.
- 1904. Twenty-second Report of the Agricultural Experiment Station for 1903-1904.

TECHNICAL BULLETINS—ENTOMOLOGICAL SERIES.

- Vol. 1, No. 1—Wing Veins of Insects.
- No. 2—Catalogue of the Ephydridæ.

BULLETINS.

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